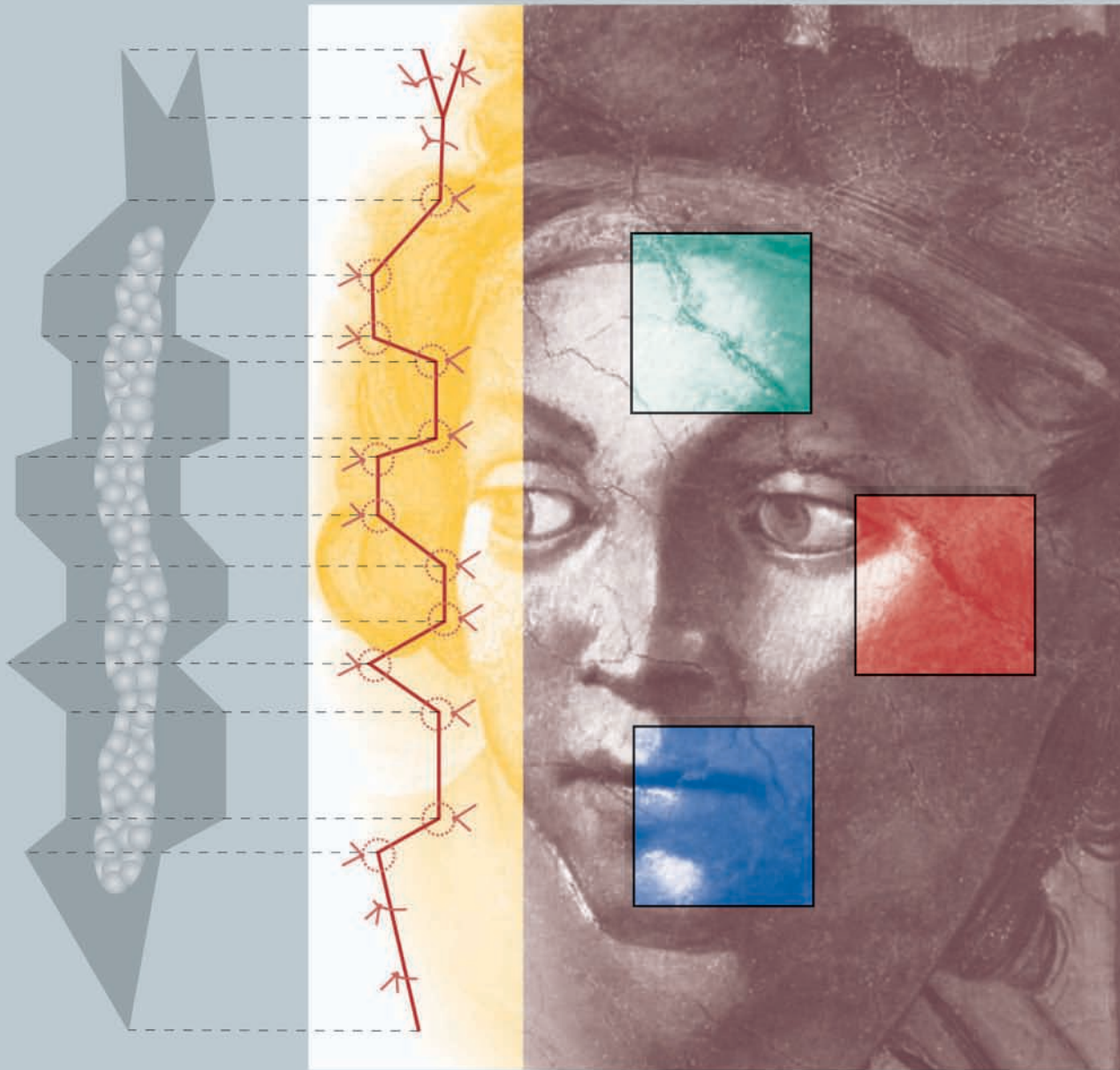


Reconstructive Facial Plastic Surgery

A Problem-Solving Manual

Hilko Weerda



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Foreword

As president of the European Academy of Facial Plastic Surgery I have the pleasure and privilege to write a foreword in this textbook on plastic reconstructive surgery of the face. This practical step-by-step surgical guide was written by professor Hilko Weerda, who is particularly well-known worldwide for his auricular reconstruction techniques and is also an expert in facial plastic reconstructive surgery and teaching.

This book is well illustrated with bicolour drawings is easily accessible with clear compact text and very instructive step-by-step illustrations of the various techniques.

The basics of facial surgery are covered in the first part of the book and more advanced defect closure techniques in various regions in the second part. With the supplementary chapters by the co-authors St. Remmert and K. Sommer on myocutaneous island flaps, delto-pectoral flaps, and free microvascular transplants, this book covers the most contemporary

techniques in plastic and reconstructive surgery of the face.

This practical guide will be of great help to the neophyte facial plastic surgeon but will also be of interest to more experienced surgeons due to the huge amount of information it contains on the various technical solutions for facial defects.

Professor Hilko Weerda and his co-authors have to be congratulated on this vital and practical guide to facial plastic surgery, which hopefully will stimulate the further development of high quality facial plastic and reconstructive surgery in our ENT speciality throughout Europe.

Gilbert J. Nolst Trenité, M.D.
President of the European Academy
of Facial Plastic Surgery
University of Amsterdam
Department of Ear, Nose, and Throat
1100 DE Amsterdam/Netherlands

Foreword

Balancing the twin needs of functional and aesthetic facial defect reconstruction has challenged surgeons over the centuries to develop practical and utilitarian repair solutions. Professor Hilko Weerda, in typical meticulous fashion, presents in this text atlas a virtual encyclopaedia of reconstructive options for the thoughtful repair of a wide-ranging group of facial, head, and neck defects. The multiple options and alternatives available for defect repair and reconstruction presented in this volume have met the test of time world-wide.

Reconstruction in the head and neck region requires a dedication to meticulous planning. Facial plastic and reconstructive surgery is, in its finest sense, a craft best developed over time and seasoned with experience. The thought process required in the planning of facial repair probably supercedes the technical skill involved in the surgical event itself. Techniques highly useful and indicated in one region of the face may not serve well for adjacent regions. Skin thickness, skin mobility, the presence of hair-bearing structures, and the junctions of facial landmarks must all be considered when the *most appropriate surgical option* is chosen. A tissue price is paid (by the patient) whenever regional tissues are advanced, rotated, transposed, or interposed to reconstruct defects—scarring, distortion, and asymmetries

of the donor as well as the recipient site are ever-present possibilities. The surgeon's critical responsibility is to diminish the amount of that price to be paid by employing the correct reconstructive option. Given our present state of knowledge, the majority of challenging facial repairs should produce a *functionally useful* and *aesthetically admirable* outcome. As the brilliant reconstructive surgeon Gary Burget states: “the eye does not perceive cover, lining or support. It sees a pattern of graduated light and shadow ... color, texture and most importantly contour create the visual image ...”.

Professor Weerda has succeeded admirably in authoring a comprehensive compendium designed to aid the reconstructive surgeon in assessing the various options and alternatives for facial repair.

M. Eugene Tardy, M.D., F.A.C.S.
Professor Emeritus of Clinical Otolaryngology—
Head and Neck Surgery
Director of Facial Plastic Surgery
Department of Otolaryngology—
Head and Neck Surgery
University of Illinois Medical Center
Chicago, Illinois, USA

Preface

Particularly in this age of mass media, the face plays a pivotal role in human self-identification. Malformations, defects, and bony or soft-tissue changes caused by trauma or neoplasms can drastically alter the patient's appearance, frequently impacting on his or her feeling of self-worth. Drawing on our experience in the operating room and our many years of planning and conducting courses in plastic and reconstructive surgery, we have created an easy-to-use, step-by-step surgical textbook for the face and neck based on informative illustrations and concise text. Sequences of drawings provide both the novice and the experienced facial surgeon with simple, reproducible solutions to many of the most commonly encountered problems and questions in facial plastic surgery.

Along with the most commonly practiced reconstructive procedures, a number of other proposed technical solutions are presented largely without commentary.

I express thanks to my colleagues St. Remmert and K. Sommer for their contributions on myocutaneous flaps and free tissue transfers. I thank Mrs. Böhm for the immense typing work and Mrs. Schumacher for providing the drawings, which consistently conformed to the author's wishes.

I also thank Dr. Bergman, Mrs. Müller-Baji, Mr. Krüger, and Thieme Publishers for their outstanding work in the production of this book.

Lübeck, summer 2001

H. Weerda

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1 Anatomy of the Skin and Skin Flaps

The Skin

(Fig. 1.1)

The skin is composed of epithelial layers (epidermis) and the dermis. Below the skin are the subcutaneous tissue, fascia, and muscle (Fig. 1.1).

Types of Skin Flaps

Random Pattern Flaps

(Fig. 1.2)

Random pattern flaps derive their blood supply from the dermal and subdermal plexus (Fig. 1.2). The **ratio**

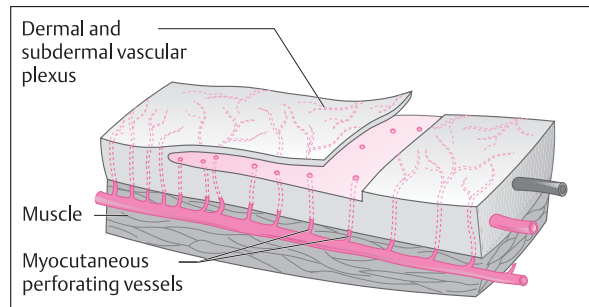


Fig. 1.2 **Random pattern skin flap** for facial use has an approximately 2:1 ratio of length to width. A special type is the subcutaneous pedicle flap (Barron et al. 1965; Lejour 1972; see Figs. 5.44 and 5.45).

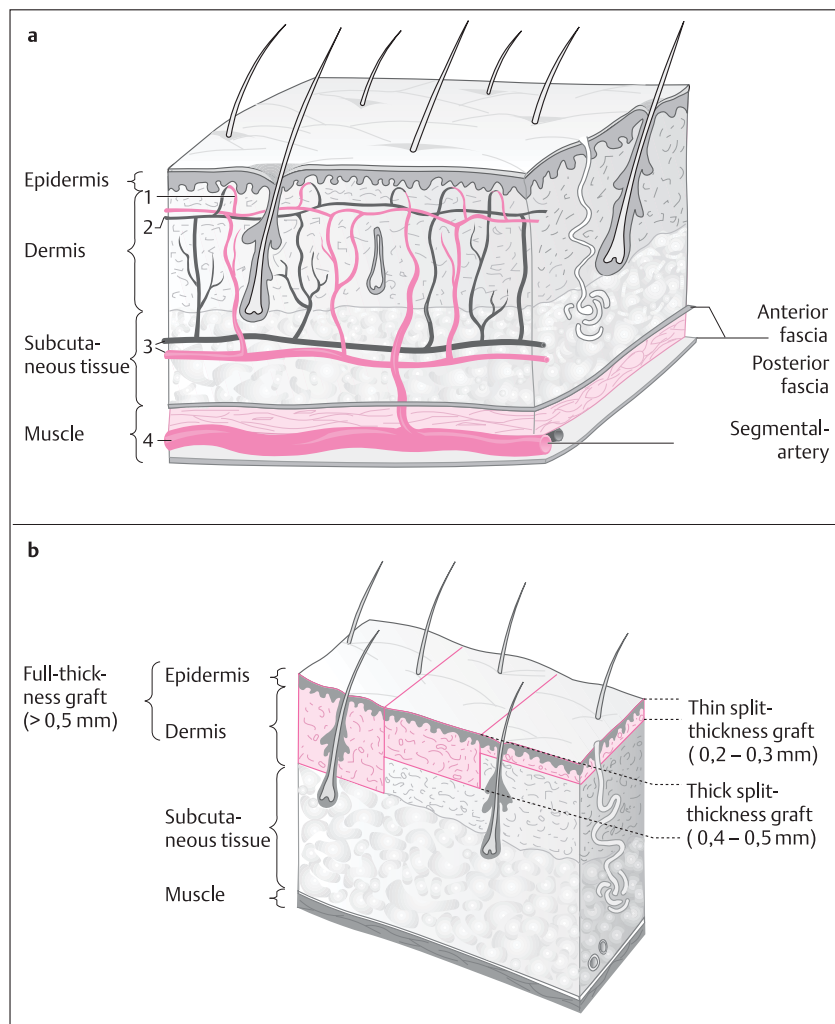


Fig. 1.1 **a Structure of the skin.**

1. Subpapillary vascular plexus
2. Dermal vascular plexus
3. Subdermal vascular plexus
4. Segmental vascular plexus

Fig. 1.1 **b Composition of free skin grafts.**

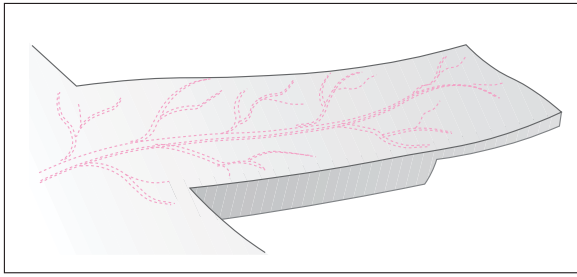


Fig. 1.3 **The axial pattern flap** is based on a specific artery. Examples are the forehead flap, Esser's cheek rotation, and the median forehead flap (see Figs. 5.49a, 6.18, and 8.1).

of flap length to flap width in the face is approximately **2:1**.

Axial Pattern Flaps

(Fig. 1.3)

An axial pattern flap is designed to be supplied by a specific arterial vessel. For example, a forehead flap can be mobilized on the frontal branch of the superficial temporal artery, and the median forehead flap can be based on the supratrochlear artery (see Fig. 5.15). A **3:1 or 4:1 length-to-width ratio** can be achieved with these flaps.

Island Flaps

(Fig. 1.4)

In an island flap, the skin is transposed into the defect on a pedicle composed of only the nutrient vessels (Fig. 1.4, see also Fig. 5.9).

Myocutaneous Island Flaps

(Fig. 1.5, see also Fig. 12.1)

The myocutaneous island flap is an axial pattern flap that generally includes skin, subcutaneous fat, muscle fascia, and muscle tissue. Familiar examples are the myocutaneous pectoralis major island flap and the myocutaneous latissimus dorsi island flap (see Fig. 12.2).

Neurovascular Island Flaps

With some flaps, sensory or motor nerves can be mobilized in addition to nutrient vessels. For example, authors have transferred neurovascular island flaps from around the mouth for use in lip reconstruction (Karapandzic 1974; Weerda 1983 a, b; Remmert et al. 1994; Figs. 6.17, 6.29, and 12.1).

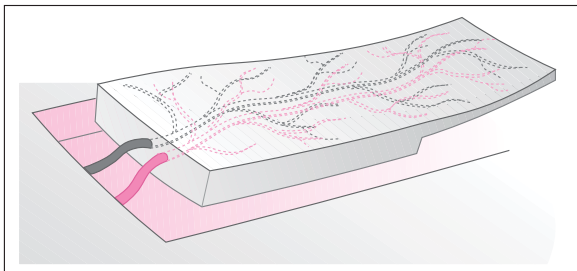


Fig. 1.4 **Island flap**. A variant of this flap is the neurovascular island flap, which includes a nerve supply (Karapandzic 1974; Weerda 1980c; Weerda and Siegert 1991; see Fig. 6.17).

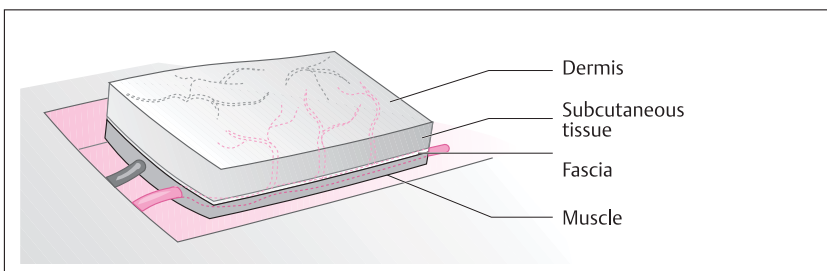


Fig. 1.5 **Axial-pattern myocutaneous island flap** (see Figs. 12.1 and 12.2).

2 Basic Principles of Facial Surgery

Suture Materials and Techniques

We use atraumatic cutting needles for the skin, and we generally use round needles for the mucosa. Our suture material of choice for the face is 6-0 or 7-0 monofilament on a very fine needle. Occasionally we use 5-0 monofilament for areas that are not visible. Prolene®, PDS®, P1 and P6 5-0 needle with P3 or PS 3 needle.

Our subcutaneous sutures are composed of absorbable or fast-dissolving braided or monofilament material. Vicryl or PDS, P1, P3 needle Ethicon, Norderstedt, Germany.

A suture or suture line must remain in place only until the wound has healed to an adequate tensile strength. Leaving sutures in too long results in ugly scarring of the needle tracks.

Sutures are removed as early as possible. Sutures in the eyelid area or near the border of the lip should be removed on the fifth postoperative day, sutures in other facial areas on day five or six. If sutures have been placed under tension, we remove them on day seven or eight. Sutures in the posterior auricular surface are removed on day eight.

The simple interrupted suture (Fig. 2.1) is most commonly used. Each surgical knot should be tied with at least two or preferably three throws tied in opposite directions.

We generally use continuous sutures (Fig. 2.2) for the lid area, for long traumatic wounds, and behind the ear in auricular reconstructions. After every three or four stitches we usually tie an intermediate knot to obtain a secure coaptation.

The tightened suture should raise the wound edges slightly so that the scar will be at skin level following scar contraction. With deep wounds, a subcutaneous approximating suture is placed initially with a buried knot (Fig. 2.1a, b).

In areas where two skin incisions meet at an angle, we generally use a Donati or Allgöwer type of vertical mattress suture to coapt the wound edges (Fig. 2.3). Wounds under tension are additionally reinforced with mattress sutures tied over ointment-impregnated gauze or silicone button (Fig. 2.4). These sutures are removed in 7–10 days.

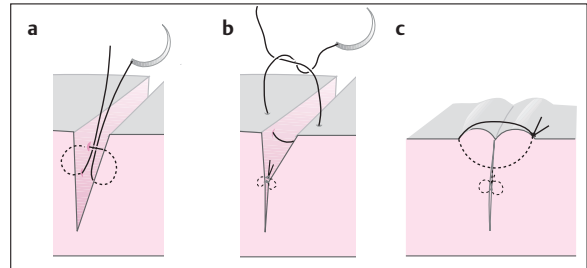


Fig. 2.1 Simple interrupted suture.

- a Subcutaneous approximating suture of absorbable material, with a buried knot.
- b The entrance and exit points are placed symmetrically.
- c The suture is tightened, slightly pursing the wound margins, and is tied on one side.

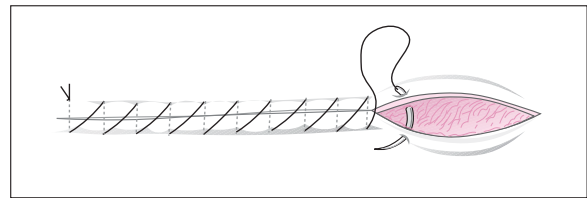


Fig. 2.2 Over-and-over continuous suture.

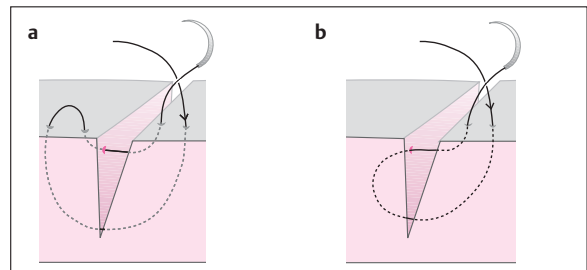


Fig. 2.3 a Vertical mattress suture (Donati type).
b Vertical mattress suture (Allgöwer type).

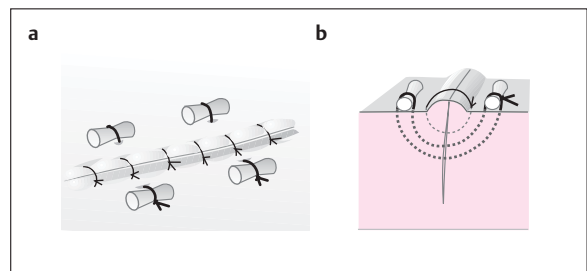


Fig. 2.4a Mattress sutures can be used to reinforce a suture line that is under tension. The monofilament threads are tied over bolsters consisting of swabs, silicone tubing, etc.
b Schematic view in cross section.

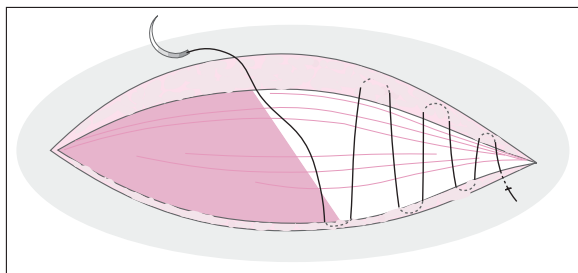


Fig. 2.5 Continuous intracutaneous suture.

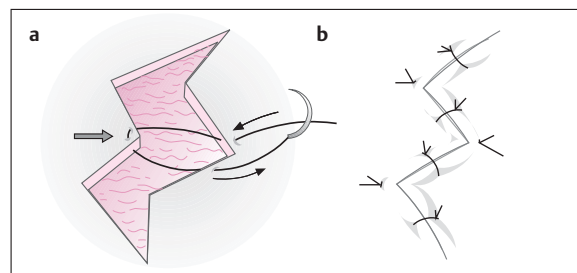


Fig. 2.6a, b Gillies corner suture.

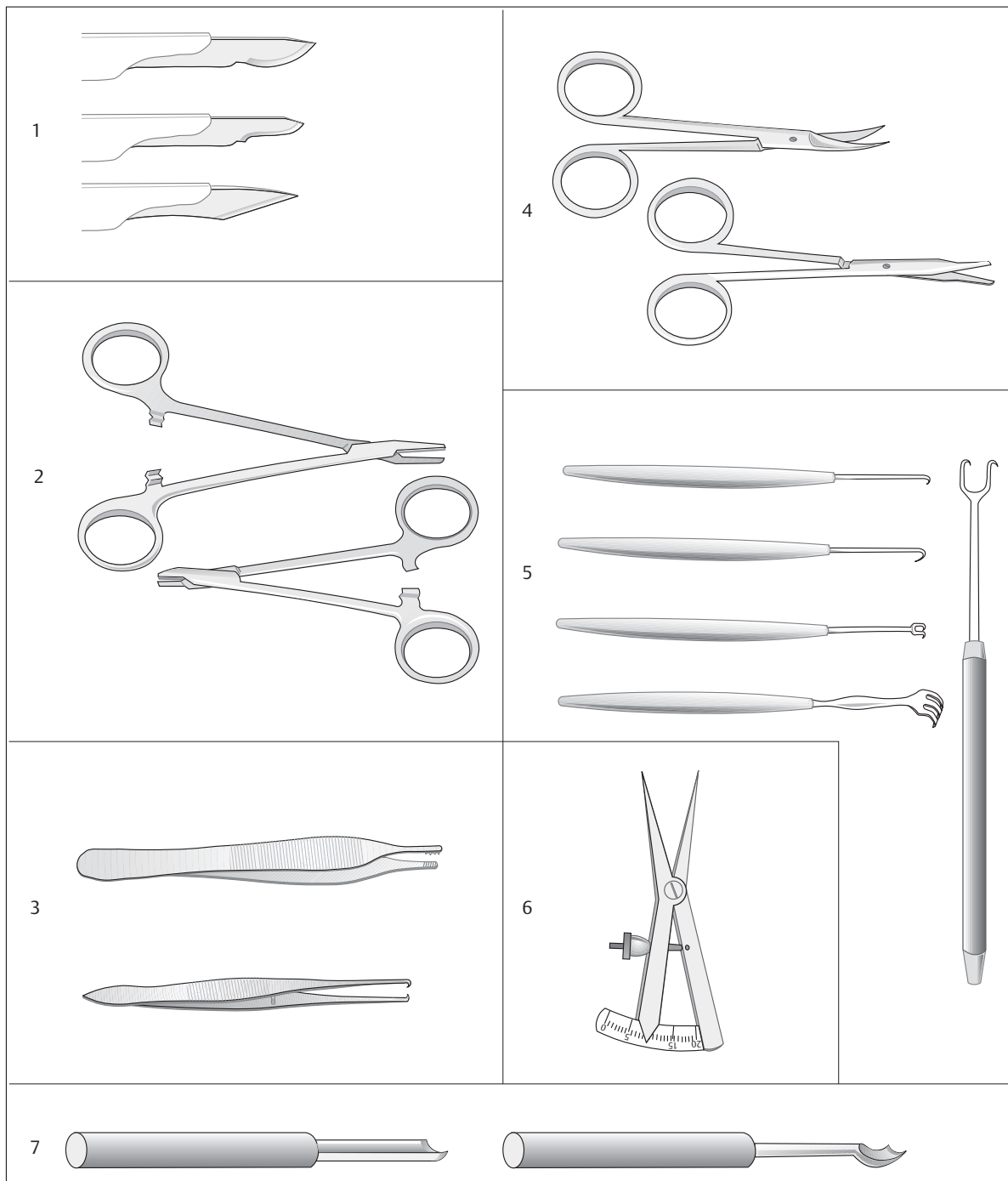


Fig. 2.7a Instruments for facial surgery (see text; from K. Storz, Tuttlingen, Germany).

The continuous intracutaneous suture can yield a more favorable cosmetic result in many surgical procedures (Fig. 2.5). We use 4-0 or 5-0 monofilament material for this type of suture.

Adhesive strips can be added to the sutures to further relieve tension on the wound edges and ensure a cosmetically acceptable scar.

The Gillies corner suture is used in angled suture lines and for the dispersion of scars (Fig. 2.6a). The needle is passed subcutaneously through the wound angle and brought out on the opposite side (Fig. 2.6b).

Instruments and Accessories

(Fig. 2.7)

We generally use a 2x to 2.5x binocular loupe when operating and suturing. A high-quality instrument set (Fig. 2.7a) is needed that includes No. 11, No. 15, and No. 19 knife blades (1) and one small and one slightly larger needle holder for atraumatic needles (2). The set should include fine surgical forceps (e.g., Adson forceps), dissecting forceps (3), fine angled bipolar forceps for vascular electrocautery, two or three fine hemostatic clamps, mucosal clamps, and assorted sharp-pointed scissors and dissecting scissors (4). Fine single-prong and double-prong hooks (5) are useful for holding and manipulating flaps. The Weerda hook forceps (Fig. 2.7b) is a good alternative, but care must be taken not to crush the flap margins with the forceps. Important accessories are a millimeter rule, a caliper (6), and sterile color markers or methylene-blue marking pencils. Suture materials consist of 5-0, 6-0, and 7-0 monofilament along with 4-0 and 5-0 absorbable braided and monofilament sutures. For cutting the auricular cartilage and other cartilaginous structures we use assorted carving tools available from K. Storz, Tuttlingen, Germany (Fig. 2.7a, 7). (See also Figs. 11.1 and 11.3).

We also use various lengths of adhesive tape for dressings and emollient ointments that often contain petroleum jelly. We routinely use suction drains and mini-suction drains to aspirate wound secretions and help contour the skin to the wound bed.

Wound Management, Repair of Small Defects, and Scar Revision

Surgical procedures of up to 2.5 hours can be conducted under local anesthesia. More extensive operations and scar revisions call for general anesthesia. Care should be taken that the tape-secured endotracheal tube does not distort the face. The face should not be taped over during operations in the facial nerve area. We use a transparent film drape for this purpose (to allow facial nerve monitoring).

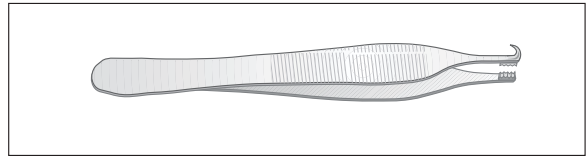


Fig. 2.7b Weerda hook forceps (K. Storz, Tuttlingen, Germany).

Relaxed Skin Tension Lines, Vascular Supply, and “Esthetic Units”

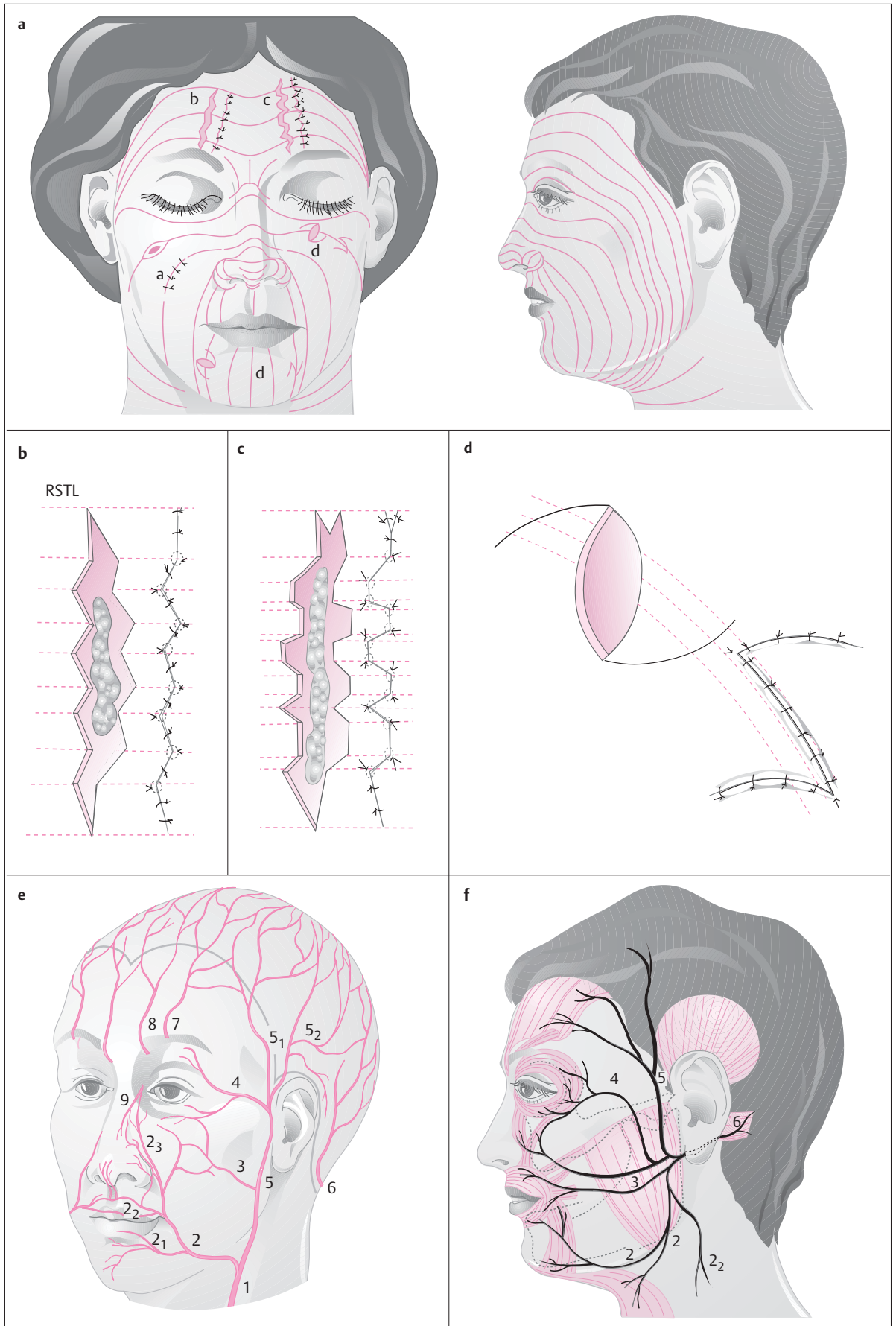
The facial surgeon must be familiar with the location and distribution of the relaxed skin tension lines (RSTLs) in the face, the facial “esthetic units” (Fig. 2.20a–c), and the vascular supply of the face (Fig. 2.8e). Besides the RSTLs, attention should also be given to **wrinkle lines** in the aging face.

Incisions or small excisions and sutures placed in the RSTLs will heal with fine, unobtrusive scars. Incisions and excisions made at right angles to these lines will often lead to broad, unsightly scars. Thus the plastic surgeon should always try to place the cuts used for incisions, excisions, and scar revisions (q.v.) in these lines to achieve good cosmetic results.

The term “**esthetic units**” (see Fig. 2.20a–c) refers to circumscribed facial regions that should each be reconstructed as a separate unit whenever possible. The radical excision of tumors takes precedence over esthetic units, however. We shall return to this reconstructive concept in the sections that deal with specific facial regions.

Wound Management and Scar Revision

It is a general rule in facial plastic surgery to sacrifice as little skin as possible. Small wounds that extend obliquely into the tissue should be straightened whenever the surrounding tissue can be mobilized and the wound edges coapted without tension. A subcutaneous suture with a buried knot should always be placed to allow tension-free approximation of the wound margins (see Fig. 2.1). Because the subcutaneous tissue, epidermis, and dermis take different lengths of time to achieve adequate wound strength, early removal of the skin sutures from a wound without subcutaneous sutures would result in a broad, unsightly scar.



◁ Fig. 2.8 **Relaxed skin tension lines (RSTL) and scar revision**, front and side views.

- a **Elliptical excision** in the RSTLs.
- b Scar excision by **W-plasty**: The W-plasty is an interdigitating, zigzag-shaped excision with segment lengths of 3–4 mm.
- c Scar excision by the **broken-line technique** creates skin tags of varying shapes with an edge length of 3–5 mm. The edges interdigitate and should follow the RSTLs as closely as possible.
- d **Z-plasty** following scar excision in the face. The new scars are oriented along the RSTLs.
- e The face derives its **arterial blood supply** from the external carotid artery and anastomotic areas:
 - 1 External carotid artery
 - 2 Facial artery
 - 2.1 Inferior labial artery
 - 2.2 Superior labial artery
 - 2.3 Angular artery
 - 3 Transverse facial artery (from 5)
 - 4 Zygomatico-orbital artery (from 5)
 - 5 Superficial temporal artery
 - 5.1 Frontal branch
 - 5.2 Parietal branch
 - 6 Occipital artery
 - 7 Supraorbital artery
 - 8 Supratrochlear artery
 - 9 Dorsal nasal artery
- f The **facial nerve** and its distribution in the face.
 - 1 Trunk from the stylomastoid foramen
 - 2 Marginal mandibular branch
 - 2.2 Cervical branch
 - 3 Buccal branches
 - 4 Zygomatic branches
 - 5 Temporal branches
 - 6 Posterior auricular branch

Scar Revision by W-Plasty and the Broken-Line Technique of Webster (1969)

(Fig. 2.8b, c)

If time permits in trauma cases, the wound should be dispersed with a W-plasty, broken-line excision, or Z-plasty that conforms to the RSTLs. If this is not possible, scar revision should be postponed for at least 6 months to 1 year. Long scars are very conspicuous, especially when they cross RSTLs at right angles. Scar revision therefore has two goals:

- **Dispersing a long scar into smaller individual scars.**
- **Positioning the smaller scars in RSTLs.**

Revision techniques involve excising the scar and dispersing the wound line into multiple segments. The **W-plasty** consists of segments 4–5-mm long arranged in a zigzag pattern (Fig. 2.8b). The new scars run in alternating directions and are barely perceptible after the wound has healed. In the **broken-line technique** the segments are placed in an irregular pattern (Fig. 2.8c). In both the W-plasty and broken-line techniques, the margins of the excision are fashioned so that they will fit together precisely like a lock and key. Generally this is done with a No. 11 blade that is held perpendicular to the skin surface when the cuts are made. The wound edges are then undermined with a No. 15 blade or pointed scissors (Webster 1969; Borges 1973; Haas 1991). Fine scars can also be managed by dermabrasion (see Chapter 16). The suture material of choice is 6–0 or 7–0 monofilament, and subcutaneous sutures should be placed whenever possible. Corners and triangles are secured with Gillies corner sutures (Fig. 2.6).

Management of Wounds with Traumatic Tattooing

If a wound contains embedded grit and dirt, it should first be scrubbed with a sterile toothbrush or hand brush and antiseptic soap until all dirt residues have been removed. It can be extremely tedious to remove these particles after the wound has healed.

Small Excisions

When an **elliptical excision** is made in the RSTLs, the wound angle should not exceed 30° (Figs. 2.8a and 2.9). Various excision techniques can be used (Figs. 2.10–2.14).

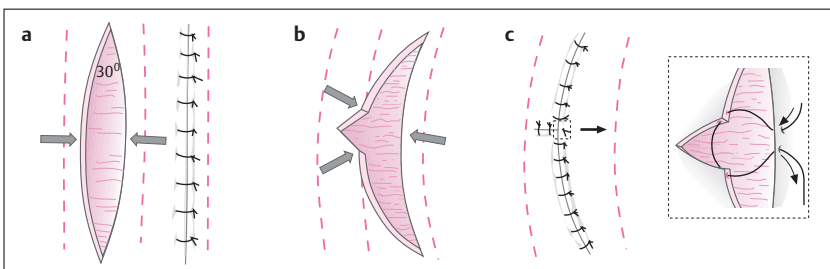


Fig. 2.9a **Elliptical excision** in the RSTLs. The excision angle is approximately 30°.
b Crescent-shaped excision.
c Suture.

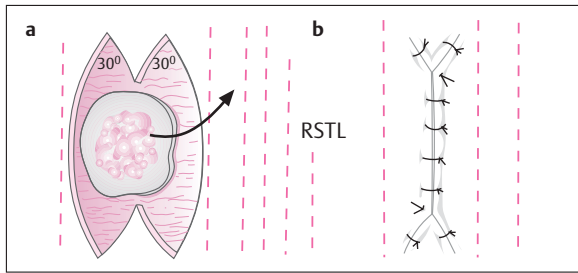


Fig. 2.10 **a Double M-plasty.** Each excision angle is 30°. **b Closure.**

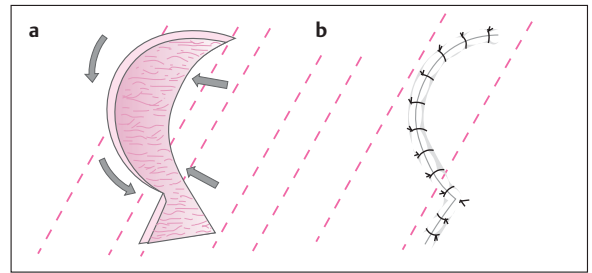


Fig. 2.11 **a Crescent-shaped advancement flap** of Jackson (1985). **b Closure of the defects.**

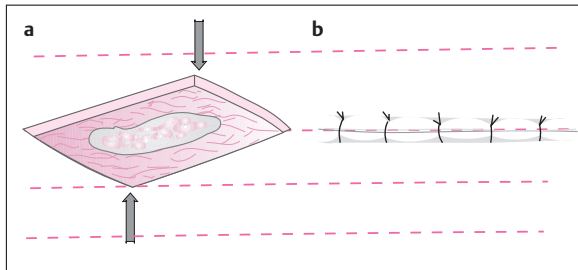


Fig. 2.12 **a Rhomboid excision.** **b Closure.**

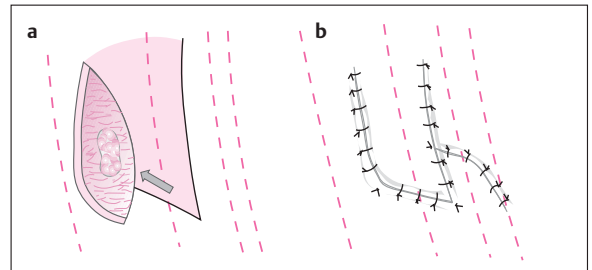


Fig. 2.13 **a Small flap advancement** for an elliptical excision. **b Closure.**

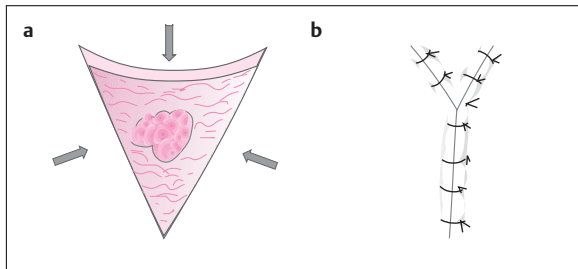


Fig. 2.14 **a Triangular excision.** **b Closure.**

Z-Plasty

(Figs. 2.15 and 2.16)

The Z-plasty is used to relieve tension on tissues that have been distorted by a contracted scar (Fig. 2.15). This technique can also disperse and redirect wounds that cross RSTLs at right angles, in which case a multiple Z-plasty can also be used (Fig. 2.16) (Jackson 1985 a).

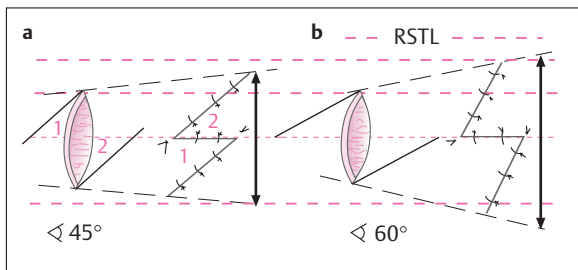


Fig. 2.15 **Simple Z-plasty.** **a** The scar, which crosses the RSTLs (--) almost at right angles, is excised and dispersed with a 45° Z-plasty. Flaps 1 and 2 are transposed, causing a slight lengthening of the tissue in the direction of the arrow. **b** Transposing flaps 1 and 2 in a 60° Z-plasty produces even greater tissue lengthening (arrow).

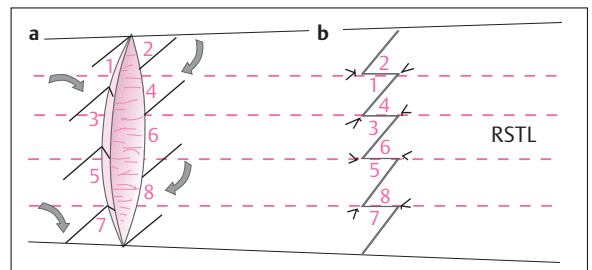


Fig. 2.16 **Multiple Z-plasty.** **a** The scar is excised, and the long scar is dispersed into multiple Z's that more closely follow the RSTLs. **b** Transposing the flaps lengthens the tissue in the direction of the scar and disperses the scar into multiple smaller flaps (see Wound Management and Scar Revision, p. 5).

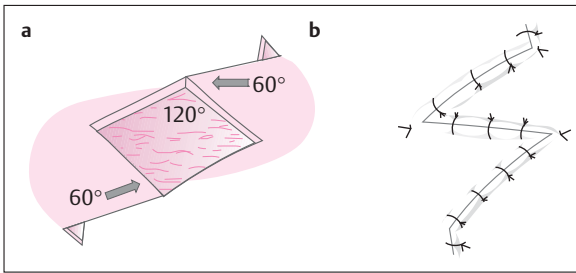


Fig. 2.17 **a** Rhomboid defect repaired by a **Z-plasty** using the technique of Pate et al. (1991).
b Closure of the defect.

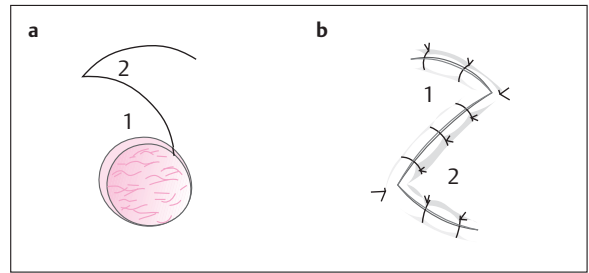


Fig. 2.18 **a, b** **Z-plasty** for the closure of small circular defects.

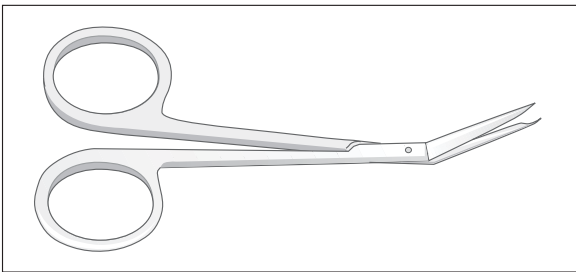


Fig. 2.19 Weerda **suture microscissors** with micro-cutting edge (K. Storz, Tuttlingen, Germany).

Numerous variations of the Z-plasty are available for repairing defects of varying size (Figs. 2.8d, 2.17, and 2.18). These techniques require a high degree of flap mobility (Cummings et al. 1986).

Postoperative Treatment of Scars

We use a microscissors (Fig. 2.19) for cutting and removing the sutures on postoperative day five, six, or seven. A cortisone ointment is massaged into the scar for 15 minutes in the morning and evening for 2 weeks. If the patient is prone to hypertrophic scarring, we inject a 1:2 dilution of Volon A crystal suspension (10 mg Volon A diluted with 2 mL of physiologic saline).

Esthetic Units

(Fig. 2.20)

If portions of the face need to be reconstructed, better cosmetic results are achieved by reconstructing areas as complete units. This is not always possible, however, especially in tumor resections.

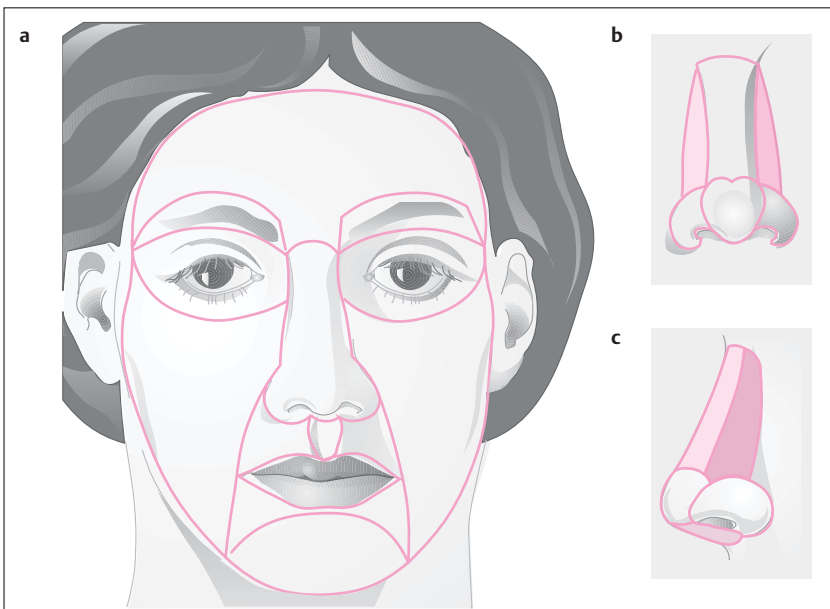


Fig. 2.20 **Esthetic units**

a In the face,
b nasal subunits, anterior view,
c nasal subunits, lateral view.

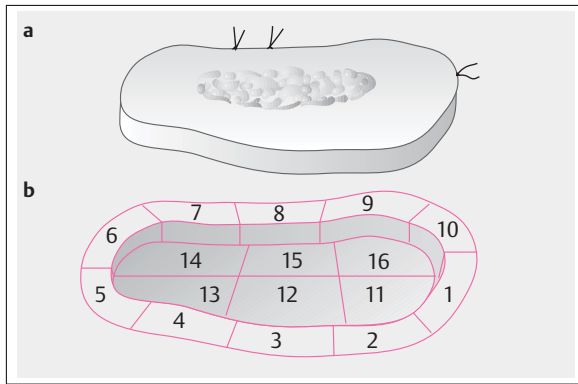


Fig. 2.21 Tumor resection with histologic control.

- a The skin tumor is removed with a margin of healthy tissue, and the edges of the specimen are marked with threads.
- b The margins and base of the tumor bed are resected in a clockwise direction and checked histologically to verify complete **tumor clearance**.

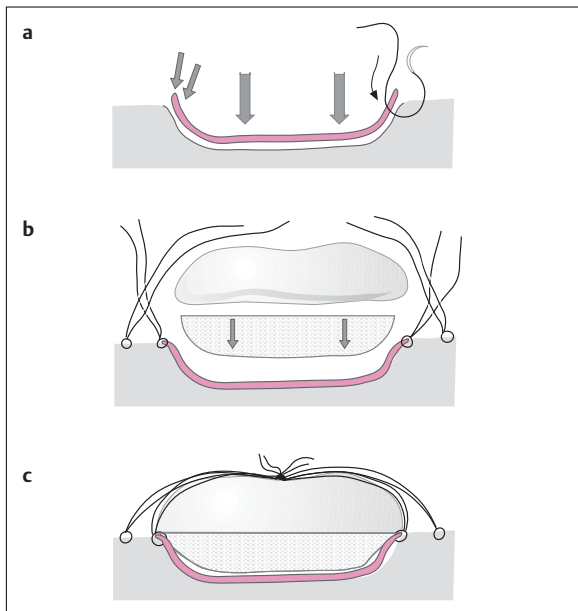


Fig. 2.22 Free skin grafts.

- a Following meticulous hemostasis, the split-thickness or full-thickness skin graft (see Fig. 1.1b) is sutured to the wound margin on one side. A thin film of fibrin glue (**Tissucol, Baxter Germany, Heidelberg**) is applied to the base of the wound, and the graft is pressed firmly against the wound bed for 30 seconds.
- b A light pressure dressing is particularly recommended in more mobile facial areas. The graft-fixation sutures are left long, and additional 4–0 sutures may be placed 1 cm from the wound margin. We cover the graft with a 1–2-mm thickness of petrolatum foam, followed by a foam or gauze bolster over which the suture tails are tied, exerting gentle pressure on the grafted site.
- c The tie-over dressing remains in place for at least 6 days.

Tumor Resection with Histologic Control

(Fig. 2.21)

Complete tumor removal takes precedence over all cosmetic and reconstructive concerns. Regardless of whether the tumor is a basal cell carcinoma, squamous carcinoma, or melanoma, it must be certain that adequate marginal and deep clearance has been achieved in accordance with oncologic principles. Wherever possible, we practice a modified form of histologically controlled tumor resection. This means that the tumor is first excised with a margin of healthy tissue, marked with threads to indicate its position in the face or neck, and outlined on paper (Fig. 2.21a). The specimen is sent to pathology, and additional samples are taken from the margins and base of the tumor bed (Fig. 2.21b), marked on a sheet of paper (e.g., glove paper), and sent to pathology for separate evaluation. The defect is not reconstructed until the histologic results are known (secondary or delayed coverage). This can minimize the recurrent rate, and the cosmetic results are as good as with a primary reconstruction. This procedure is followed even if reexcision is necessary due to positive margins.

Small tumors are elliptically excised in the RSTLs, and the wound margins are sparingly undermined and closed in two layers (see Figs. 2.8a, 2.9a). Various skin flaps can be used to cover larger defects.

Free Skin Grafts

(Fig. 2.22)

Although our tendency is to cover facial defects with local skin flaps, sometimes it is better to use a full-thickness or split-thickness skin graft to repair a tumor resection site, especially in older patients. This is especially true if the tumor cannot be excised with the requisite safety margin or if it is uncertain that the tumor has been fully encompassed. We use skin from the postauricular or retroauricular area to cover facial defects, as it most closely matches the color and texture of the facial skin. Other acceptable donor sites are the supraclavicular area and the medial surface of the upper arm. Groin skin can be used in less conspicuous areas. We have found the scalp above the ear to be a good donor region. When this skin is used for split-thickness grafts no more than 0.3 mm thick, the hair is cut very short and the skin is harvested above the level of the hair bulbs with a dermatome. The regrowth of hair will conceal the donor scars.

Large split-thickness grafts can be obtained from the buttock, from the abdominal skin, or, as a last resort, from the thigh. They are harvested using various types of dermatomes, which are set to the desired thickness of the graft. Thin split-thickness skin grafts

are harvested in a thickness of 0.2–0.3 mm, thick split-thickness skin grafts are in the range of 0.35–0.50 mm, and full-thickness skin grafts are over 0.5 mm thick (see Fig. 1.1b).

The wound bed to be grafted must be free of bleeding sites and clotted blood, otherwise the graft will not adhere to the wound bed and will be lost to necrosis. Harvesting the graft from the groin area leaves an unobtrusive, streaklike scar. The free graft should be slightly larger than the primary defect. We use a pattern made from aluminum foil (suture wrapping material) or glove paper to outline a graft of sufficient size.

Generally the graft is sutured into the wound bed with 5–0 or 6–0 monofilament (Fig. 2.22a). Fibrin glue (Baxter Germany, Heidelberg) is additionally used to support hemostasis and ensure adequate fixation of the graft in the recipient bed. The grafted site is covered with a layer of foam coated with a mixture of Betadine and petrolatum. This is covered with a petrolatum gauze bolster over which the suture tails are tied to create a light pressure dressing (Fig. 2.22b). The tie-over dressing remains in place for 6–8 days (Fig. 2.22c). The dressing can also be covered with adhesive strips.

A successful graft requires a well-perfused recipient bed. A graft placed on bare bone, for example, will not survive. If bone is exposed or if the level of the graft does not match that of the surrounding skin, special measures must be taken. When cortical bone has been exposed, drilling multiple holes down to cancellous bone will promote the formation of granulation tissue. The soft granulations are periodically removed and light pressure dressings applied to **condition the graft bed**. When the level of the bed has reached that of the surrounding skin, graft inset can be performed.

Composite Grafts

(Fig. 2.23)

Composite grafts are generally obtained from the auricle, particularly two-layer chondrocutaneous grafts and full-thickness (three-layer) grafts composed of anterior skin, cartilage, and posterior skin. They are most commonly used for nasal reconstruction but can be used in the auricle as well. Because the skin of the graft contracts slightly, it should be cut slightly larger than the defect and thus larger than the cartilage layer. Again, we use a pattern made from aluminum foil (suture material wrapper) or glove paper as a guide. The skin on the anterior side is more firmly adherent to the perichondrium and



Fig. 2.23 Donor sites where two-layer and three-layer **composite grafts** can be obtained with primary closure of the defect. A fat-dermis graft can be harvested from the earlobe.

cartilage than the posterior skin. If the retroauricular skin is included in the graft, it should be tacked to the cartilage with a few simple interrupted sutures to prevent separation.

The donor defect may be closed by direct suture or covered with a retroauricular island flap (see Fig. 10.1). When the composite graft is handled, care is taken not to crush its edges with the forceps, and the fixation sutures should not be placed too close together. Dark discoloration of the graft during the first few days is no cause for alarm, but approximately 20% of these grafts do not survive (Walter 1997). The dressing over the composite graft should keep it immobile for 6–7 days if possible to avoid tearing the capillary buds that revascularize the graft.

Graft Nomenclature

Autologous: The donor and recipient are the same (*autograft*).

Isogeneic: The donor and recipient are genetically identical (e.g., monozygotic twins, animals of a single inbred strain; *isograft* or *syngraft*).

Allogeneic: The donor and recipient are of the same species (human–human, dog–dog; *allograft*).

Xenogeneic: The donor and recipient are of different species (e.g., bovine cartilage; *xenograft* or *heterograft*).

Prosthetic: Lost tissues are replaced with synthetic materials such as metal, plastic, or ceramic (*prosthetic implants*).

3 Coverage of Defects

Local Flaps

Local flaps are flaps that are raised from tissues in the immediate vicinity of the defect.

Advancement Flaps

Advancement Flap of Burow (1855) (Fig. 3.1)

Simple triangular defects can be covered by advancing the adjacent skin. A small Burow's triangle is excised at the opposite end of the flap (Fig. 3.1a) to prevent formation of a **dog ear**.

Burow's U-Advancement (Figs. 3.2–3.7)

The U-shaped skin advancement requires the excision of two Burow's triangles (Fig. 3.2a). The length-to-width ratio of the standard U-flap should not exceed 2 : 1, and a 3 : 1 ratio is allowed only in exceptional cases.

In the Stark modification of the U-advancement (quoted in Jost et al. 1977), the flap is widened toward its base. Cut-backs can be added to increase the flap length (Fig. 3.3a). The extra small defects created by the flap are closed by mobilizing the surrounding skin (Fig. 3.3b). Other modifications are shown in Figures 3.4–3.7.

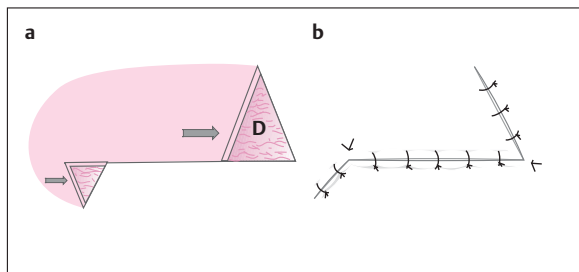


Fig. 3.1 **Advancement flap** of Burow (1855).

- a** The flap is incised along the base of the wedge-shaped defect, and a small Burow's triangle (arrow) is excised on the opposite side. The skin is mobilized and shifted in the direction of the arrow to close the defect. Excising the small Burow's triangle eliminates a dog ear at the base of the flap.
- b** Appearance after coverage of the defect.

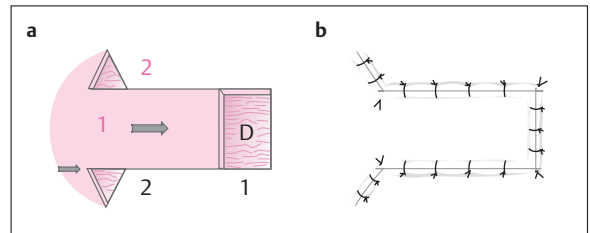
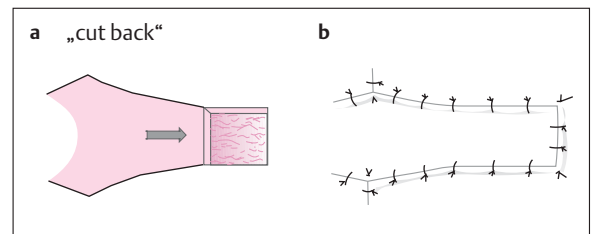
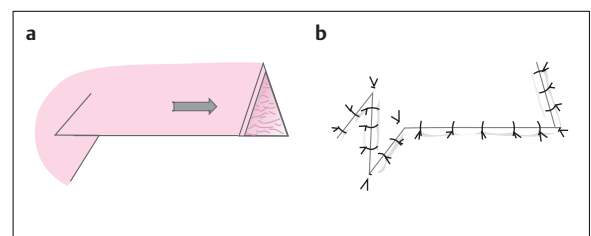


Fig. 3.2 **U-advancement** of Burow.

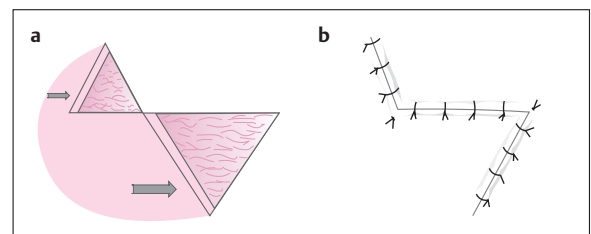
- a** The ratio of defect length to flap length is approximately 1 : 2, and the base-to-length ratio of the flap should not exceed 1 : 2. The flap is advanced by excising two small Burow's triangles and mobilizing the surrounding skin.
- b** Closure of all defects.



3.3

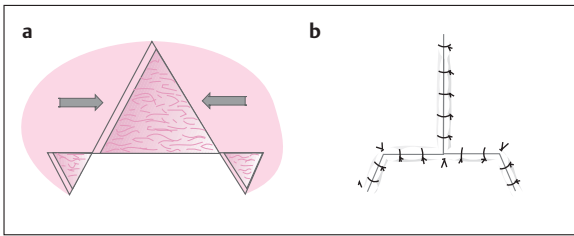


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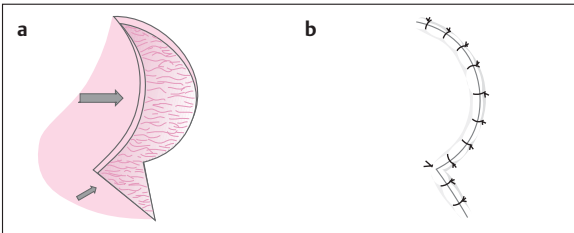


3.5

Figs. 3.3–3.5 Modifications of defect closure using Burow's triangles.



3.6



3.7

Figs. 3.6 and 3.7 Modifications of defect closure using Burrow's triangles.

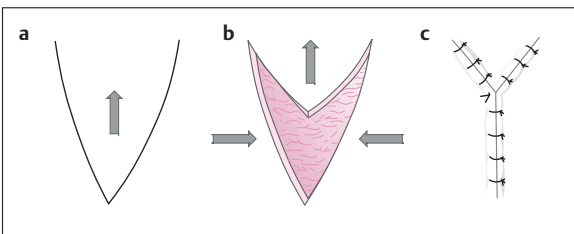


Fig. 3.8 **V-Y advancement**

a A contracted scar or the frenulum can be lengthened by making a V-shaped incision, mobilizing the flap, and advancing it in the direction of the arrow.

b The skin is mobilized.

c Closure of the defects.

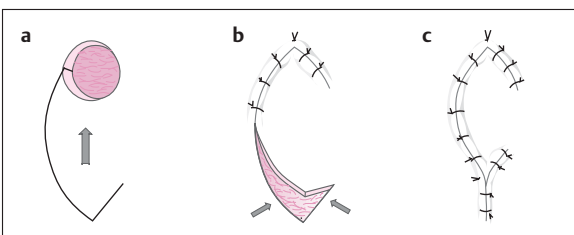


Fig. 3.9 Modification of the V-Y plasty.

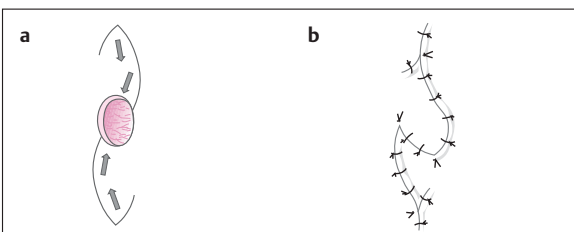


Fig. 3.10 **a, b V-Y-S advancement** of Argamaso (1974).

V-Y and V-Y-S Advancement of Argamaso (1974)

(Figs. 3.8–3.10)

The V-Y advancement and double V-Y-S advancement of Argamaso (1974) are special designs used for releasing contracted scars, for columellar reconstruction from the upper lip, and for lengthening the frenulum (Fig. 3.8).

Flaps without Continuous Epithelial Coverage (Rettinger 1996)

Sliding Flap

(Figs. 3.11–3.14)

Another interesting type of advancement flap is the sliding flap, which is based entirely on subcutaneous tissue. Barron et al. (1965) devised a flap with a lateral subcutaneous pedicle (Fig. 3.11). The skin flap is outlined, and the pedicle is mobilized on one side. The flap is slid into the defect on the subcutaneous pedicle. Lejour (1975) described a similar flap based on subcutaneous tissue (Fig. 3.12; see also Figs. 3.13 and 3.14). We have used this type of flap to repair defects in the tongue (Weerda 1985, Fig. 3.14).

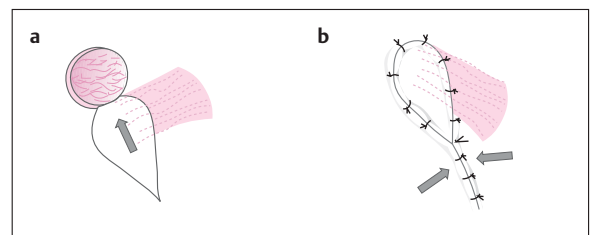


Fig. 3.11 **Sliding flap** of Barron et al. (1965).

a Flap with a lateral subcutaneous pedicle.

b Closure of the defects.

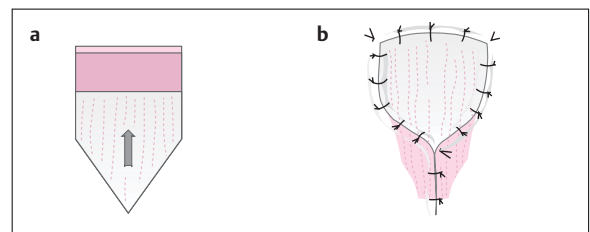


Fig. 3.12 **Sliding flap** of Lejour (1975), based on the subcutaneous tissue below the flap.

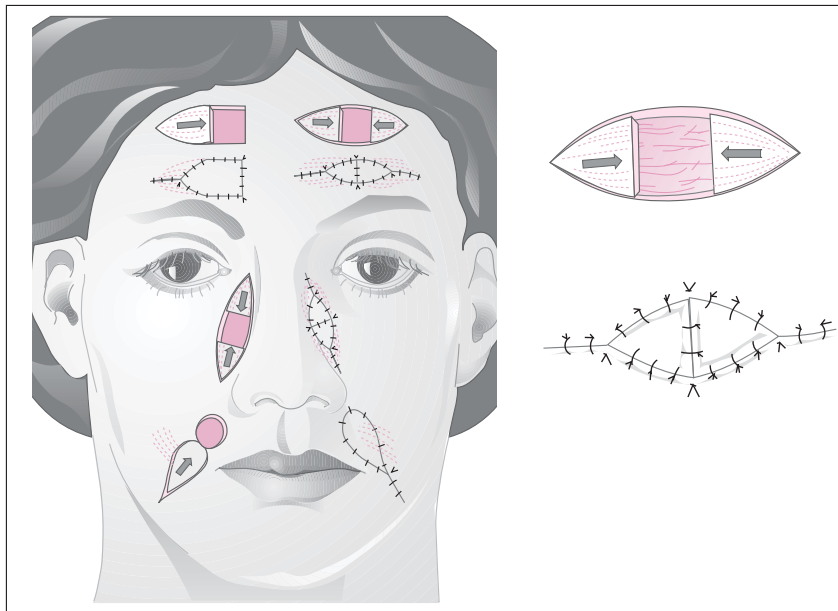


Fig. 3.13 Examples and modifications of sliding flaps for facial plastic surgery.

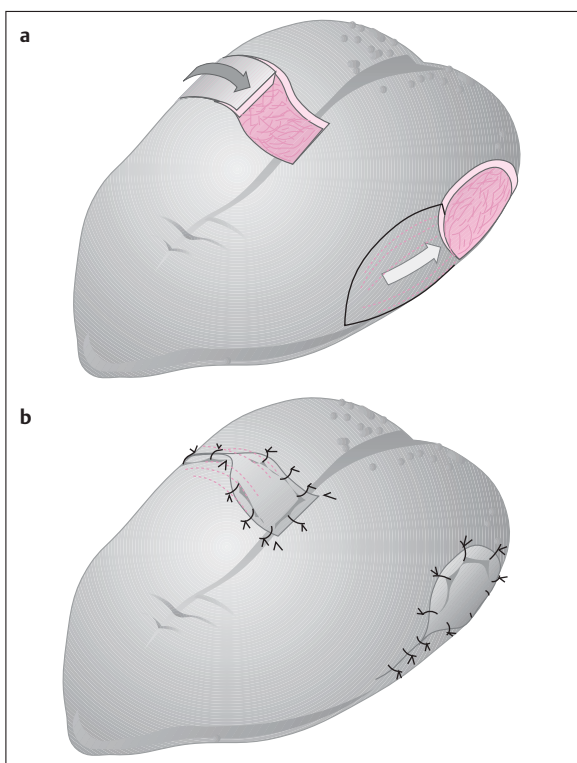


Fig. 3.14 Myomucosal sliding flap of Weerda (1985 b).

- a The sliding flaps have been outlined.
- b The flap is slid into the defect on a lateral muscle pedicle, and the defects are closed.

Pediced Flaps

Transposition Flap

(Fig. 3.15)

This flap must be large enough for transfer into a local defect (D). The surrounding skin can be mobilized for primary coverage of the secondary defect (S)

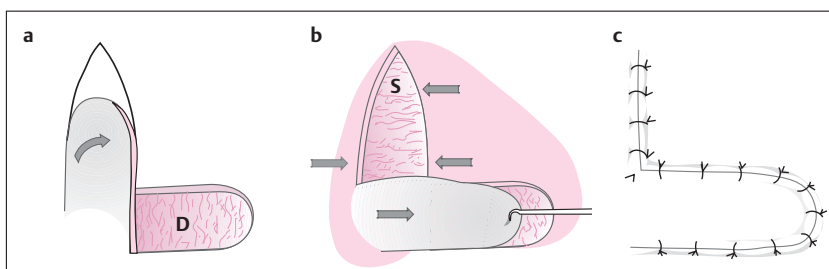


Fig. 3.15 Transposition flap

- a The transposition flap is outlined at a 90° angle to the defect (D).
- b The flap is swung into the defect, and the secondary defect (S) is closed by advancing the surrounding skin.
- c Appearance after closure of all defects.

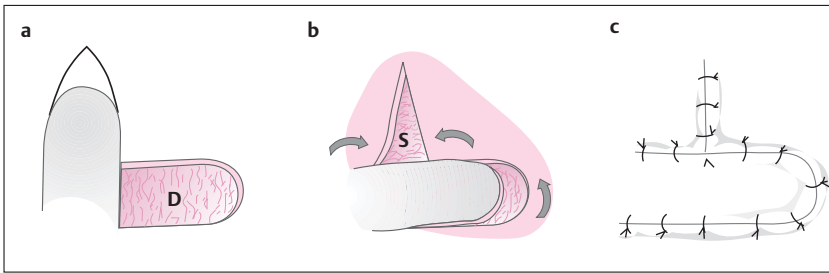


Fig. 3.16a–c Other options for closing the secondary defect.

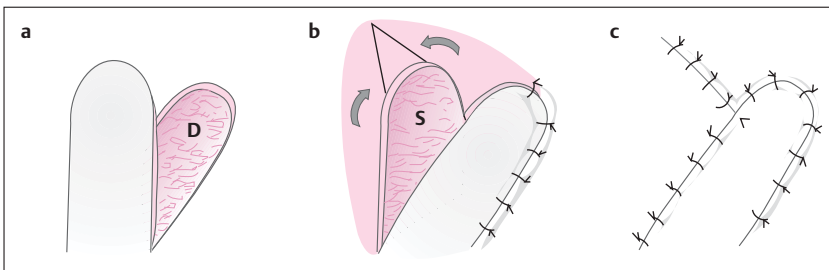


Fig. 3.17 Other options for **transposition** and mobilization.
a Transposition flap.
b Additional skin is excised to allow closure of the secondary defect (S).
c Closure.

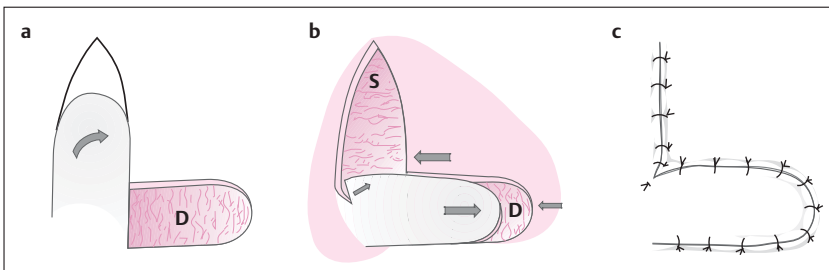


Fig. 3.18 **The surrounding skin is mobilized and advanced** in the direction of the arrow.
a The transposition flap is too short.
b A back cut is made to lengthen the flap (while **preserving an adequate base**).
c Closure of all defects.

(Figs. 3.15b, c, 3.16, 3.17). The flap may be swung through an acute angle (Fig. 3.17), a 90° angle, or even more than 90° depending on the mobility of the surrounding skin. If the transposition flap is too short but has a broad enough base, the flap can be lengthened by adding a back-cut (Fig. 3.18). Care is taken that the residual base is still adequate for flap nutrition (Haas 1991; Weerda 1978 a). (Figs. 3.15–3.18)

Rotation Flap (Fig. 3.19)

This is a semicircular skin flap that is rotated into the defect on a pivot point. Again, the flap must be sufficiently broad, and a broad base is necessary if a back-cut is needed to lengthen the flap (Fig. 3.20). If the rotation flap is too small (Fig. 3.21a), the residual defect can be covered by mobilizing the surrounding skin (Fig. 3.21b, c).

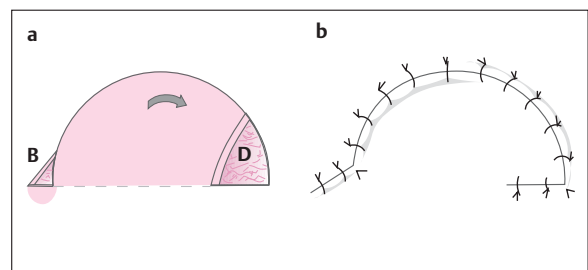


Fig. 3.19 **Rotation flap**

a The mobilized flap is rotated into the defect (D) after the excision of a Burow's triangle (B).
b Appearance after closure of the defects.

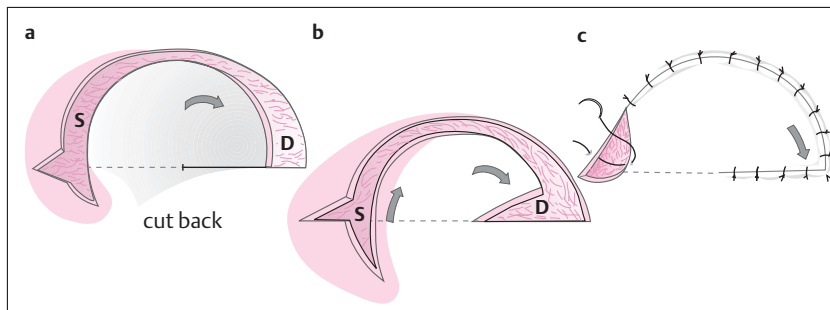


Fig. 3.20 Transfer of a too small rotation flap aided by a **back cut** (see Fig. 3.19).

- a The flap is lengthened by making a back cut.
- b The defect (D) is closed, and the secondary defect is mobilized in the area of the back cut.
- c Closure of all defects.

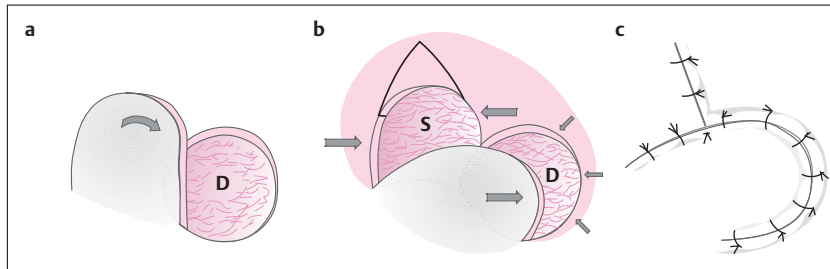


Fig. 3.21 Transfer of a too-small rotation flap aided by mobilizing the surrounding skin.

- a Flap
- b The flap is rotated, and the surrounding skin is mobilized to close the residual defect (D) and secondary defect (S). If necessary, a skin triangle is excised over the secondary defect (—).
- c Closure of all defects.

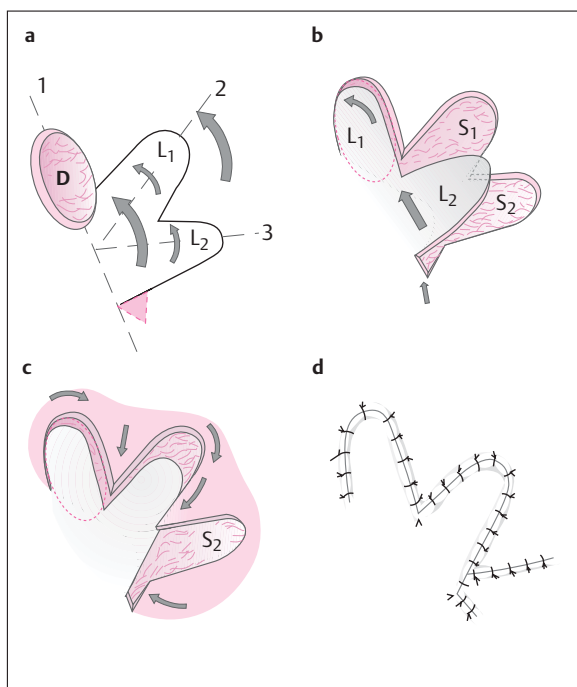


Fig. 3.22 **Bilobed flap** (Esser 1918).

- a The angle between the defect (D) and the first lobe L1 equals the angle between L1 and lobe L2. If the skin is mobile, **lobe 1 is approximately two-thirds the size of the defect**, and **lobe 2 is approximately two-thirds the size of lobe 1**.
- b The flaps and surrounding skin are mobilized, and lobe L1 is swung into the defect. Lobe L2 is swung into the secondary defect S1.
- c The surrounding skin is mobilized, and all secondary defects are closed.
- d Appearance after closure of all defects.

Bilobed Flap (Fig. 3.22)

An interesting flap design is the “bilobed flap” described by Esser (1918). The two flaps have a common base and form an angle between 45° and 180° . Smaller angles make it easier to rotate the two attached transposition flaps (Fig. 3.23), while larger angles require longer flaps and cause greater skin bunching.

These flaps are used in areas where the surrounding skin is not mobile enough to close the secondary defect, such as the **nasal flank**, the junction of the **scalp** and **neck**, the **cheek**, and the **nasal tip area** (Zimany 1953; Elliot 1969; Weerda 1978 b, c, 1980 c, d) (see Figs. 5.6, 5.8, 5.13, 5.28, 5.46, 8.19, 9.5, and 10.28).

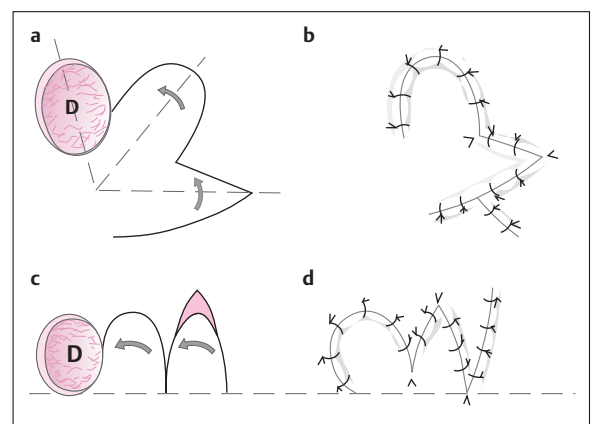


Fig. 3.23a, c **Modifications of the bilobed flap**.

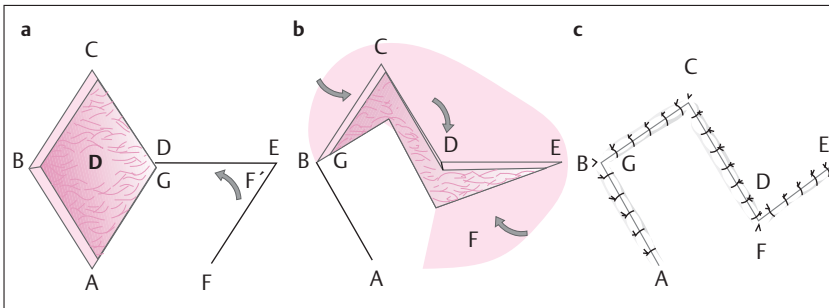


Fig. 3.24 **Rhomboid flap** of Limberg (1967).

- a** The first flap incision is an extension of the axis B-D, and the second incision (E-F) is made parallel to G-A.
- b** The flap is mobilized and the defect is closed.
- c** Appearance after closure of all defects.

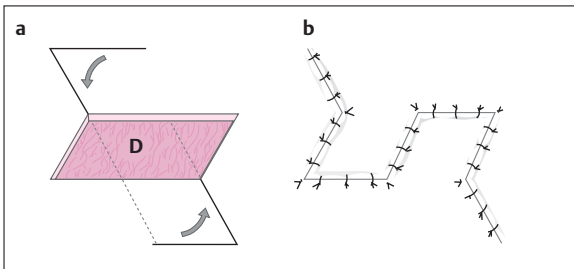


Fig. 3.25 **a** Two opposing Limberg flaps are mobilized (arrows), and all the defects are closed (**b**).

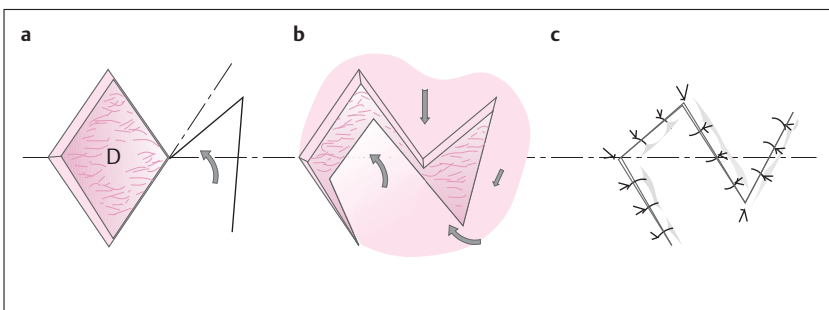


Fig. 3.26 **Rhomboid flap** of Dufourmentel (1962).

- a** Pattern of the flap incision.
- b** Mobilization and flap transfer.
- c** Closure of all defects.

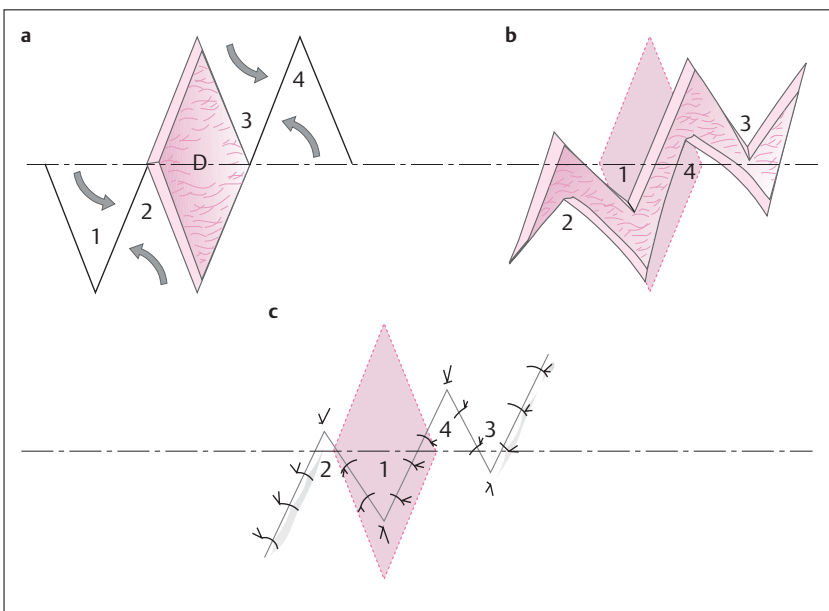


Fig. 3.27 **a-c** Defect covered with two modified rhomboid flaps corresponding to a Z-plasty.

Rhomboid Flap (Figs. 3.24–3.27)

The rhomboid flap described by Limberg (1967) is useful for reconstructing temporal or cheek defects (Figs. 3.24 and 2.25). A similar flap was described by Dufourmentel (1962) (Figs. 3.26 and 3.27).

Turnover Flap

(Fig. 3.28)

Turnover flaps can be used for nasal reconstruction, especially in the alar area (see Figs. 5.37, 5.39, and 5.46). They can also be designed as island flaps (see Fig. 5.45) and are useful for closing a tracheostoma (Fig. 3.28).

Tubed Pedicle Flap (Bipedicle Flap)

(Fig. 3.29)

The tubed flap or tubed pedicle flap is generally designed as a delayed bipedicle flap (Fig. 3.29a). Transfer is delayed for approximately 3 to 4 weeks to promote the development of a central vascular supply. First the flap is cut with a 5:1 or 6:1 length-to-

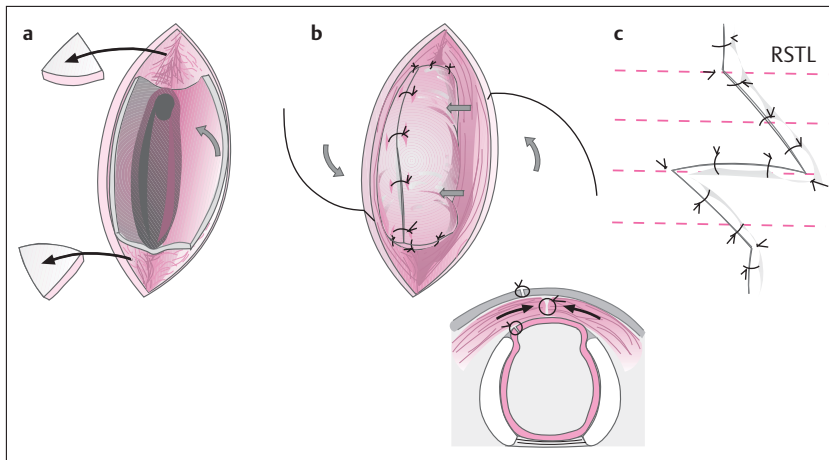


Fig. 3.28 **Turnover flaps** are used for tracheostoma closure, closing a tracheal groove, or reconstructing alar defects (see Fig. 5.39).

- a A flap of appropriate size is outlined lateral to the tracheostoma and dissected to its margin. Skin triangles are excised above and below the defect and are discarded. The tracheostoma margin on the opposite side is freshened.
- b The flap is hinged over and sutured to the freshened epithelial border. The long laryngeal muscles are mobilized to cover the turnover flap (middle layer → ←).
- c A Z-plasty is performed to close the wound and place the scar in the RSTLs (dashed red line).

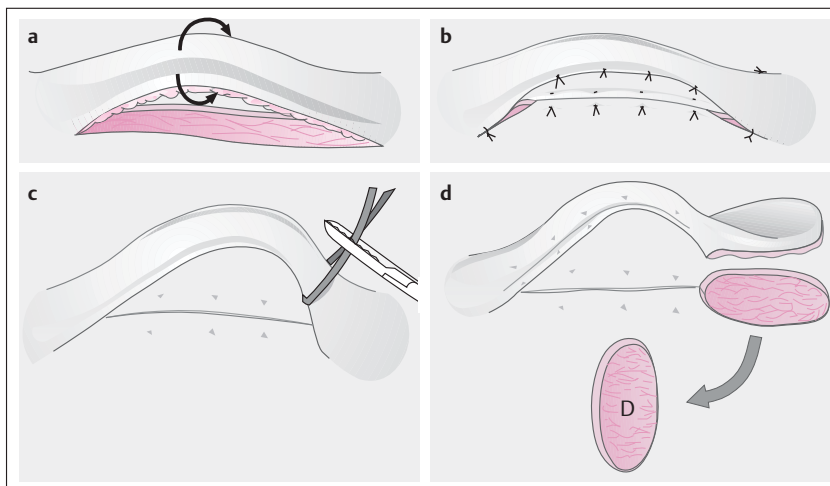


Fig. 3.29 Delayed transfer of a **tubed bipedicle flap** (see text).

- a The bipedicle flap is raised and its bridge segment is tubed. The donor defect is closed.
- b Appearance after closure of the defects.
- c About 3 weeks later, the distal end of the bridge segment is clamped off with a Nelaton catheter and clamp.
- d The distal end of the flap is detached and inset into the defect. In a second operation 3 weeks later the residual tube is divided, inset at the recipient site is completed, and the unused portion of the flap is returned or discarded.

width ratio (Fig. 3.29a) and tubed, preferably by sewing epithelium to epithelium. The proximal end of the flap is preserved as a nutrient pedicle for the “long flap.” The defect below the tube can be mobilized and closed by direct suture (Fig. 3.29b). After 3 to 4 weeks, the distal end of the bridge segment is clamped off with a thin rubber tube (Nelaton catheter). If livid discoloration occurs, the catheter is applied only briefly as a tourniquet (Fig. 3.29c). The tourniquet times are then gradually lengthened each day until the entire flap receives its blood supply from the proximal end. Finally the other end is detached (Fig. 3.29d) and sutured into the defect. This process is repeated, and in about 3 weeks the residual tube flap is removed and insetting is completed (see Figs. 5.17, 5.18, and 10.12c).

Distant Flaps

Distant Tubed Pedicle Flap

As noted above, tubed pedicle flaps can be transferred to the face from the upper arm or abdominal skin, if necessary by using a jump-flap technique. With the development of myocutaneous flaps and free tissue transfers, however, this technique is rarely used today.

Myocutaneous and Myofascial Flaps (see pp. 120, 122)

(Figs. 12.1–12.3)

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Special Part

Coverage of Defects in Specific Facial Regions

For smaller facial defects, an attempt is made to achieve coverage by means of flap advancement or local flaps (Fig. 4.1). Keep in mind that these flaps should be placed in RSTLs whenever possible (see p. 6).

If flaps cannot be obtained from the immediate vicinity of the primary defect, regional flaps are used. These are larger flaps involving the movement of tissue somewhat more distant from the recipient site.

The classic “regional flaps” from the neck and chest are no longer in common use. For the most part they

have been replaced by myocutaneous island flaps (see p. 120) and free flaps. Even the classic “distant flaps,” transferred as tubed flaps from the chest or abdomen over a period of weeks or months, are very rarely used today and have been replaced by myocutaneous flaps and free tissue transfers with microvascular anastomosis (see p. 125).

Small facial defects can be excised and reconstructed with small flaps using a technique that will place the scars as close to the RSTLs as possible (Figs. 2.7a and 4.1).

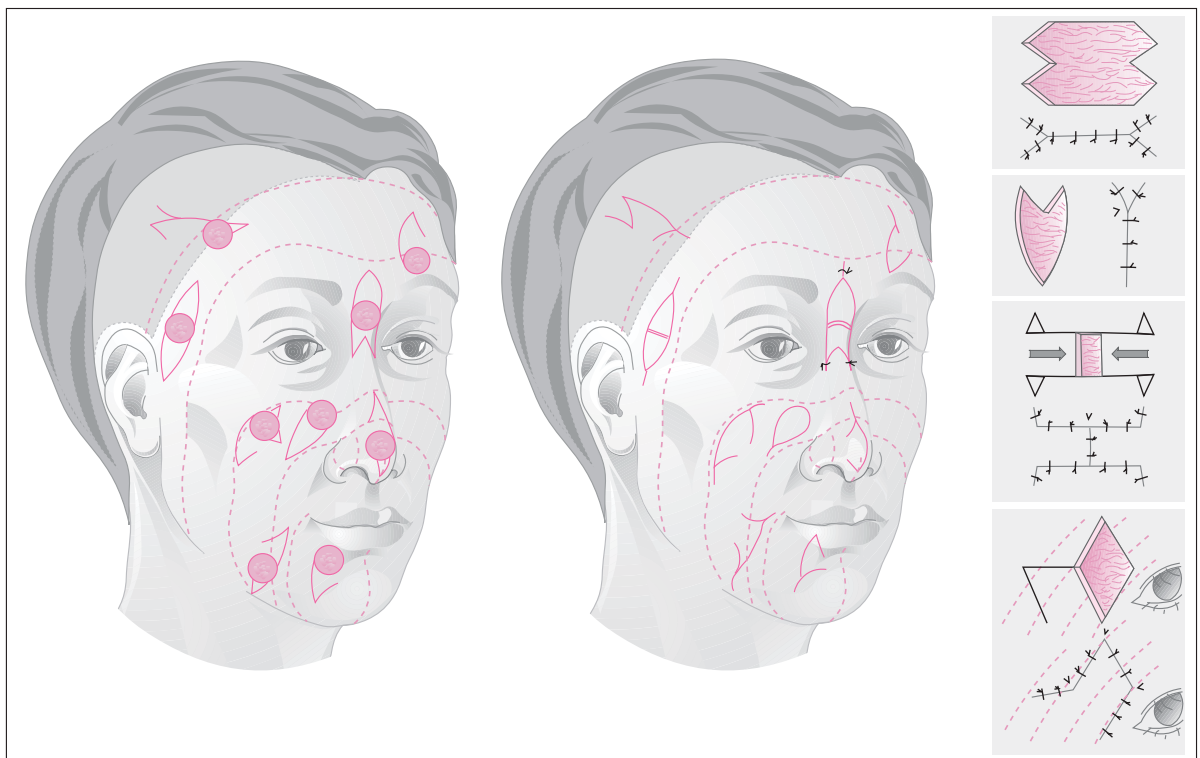


Fig. 4.1 Various **small flaps** in the face and forehead (dashed red lines: RSTLs).

4 Forehead Region

Median Forehead Region

The RSTLs run along the forehead and are perpendicular to the frown lines in the glabellar area (see Fig. 2.8a). Forehead defects up to 3.5 cm in size, especially when near the midline, can be closed by mobilizing the surrounding tissue. Primary closure can be facilitated by making parallel or perpendicular incisions in the galea. Small defects can be managed with various advancement, rotation, and transposition flaps (Figs. 3.1–3.27) and Z-plasties (Figs. 2.15–2.18).

Wedge-Shaped Defects

(Fig. 4.2)

Wedge-shaped midline defects that are based on the glabella (Fig. 4.2a) or frontal hairline (Fig. 4.2b) can be closed primarily by making an incision above the eyebrow or along the hairline and mobilizing the forehead skin.

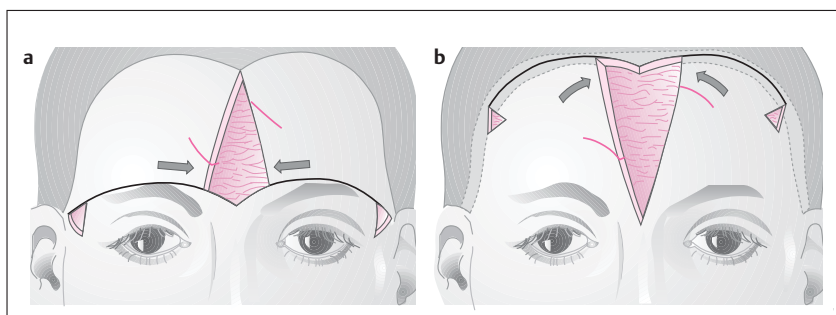


Fig. 4.2a Wedge-shaped defect in the forehead with an inferior base. An incision is made above the browline, and Burow's triangles are excised just lateral to the brow (see Fig. 4.3). The forehead skin is mobilized in the direction of the arrows. A Z-plasty (red line) can be used to disperse the scar.

b For a superiorly based defect, an incision is made approximately 1–1.5 cm behind the hairline. Lateral Burow's triangles are excised.

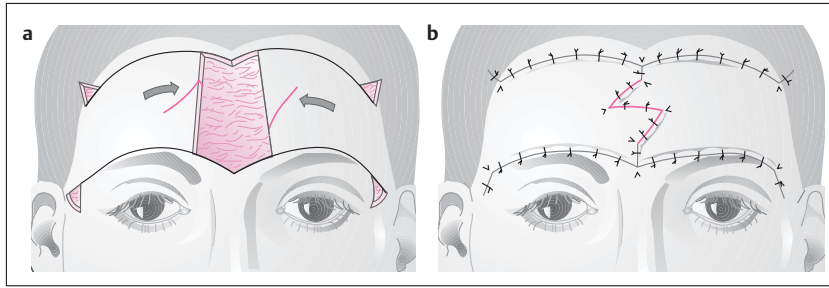


Fig. 4.3 **H-flap** (bilateral U-advancement flaps).

- a** For a midline forehead defect over 4 cm wide, an incision is made above the eyebrow and below the hairline. Lateral Burow's triangles are excised on the hairline and just behind the eyebrow to avoid cutting the frontal branch of the superficial temporal artery. The midline scar can be dispersed with a Z-plasty (red line).
- b** All defects are closed.

H-Flap

The H-flap is suitable for defects approximately 4 cm wide. Incisions are made along the eyebrow and hairline, extending through all layers in their lateral portions. The inferior Burow's triangles are placed near the eyebrow to preserve the frontal branch of the superficial temporal artery. The brow portion of the flap should be anchored to the periosteum to avoid eyebrow distortion. As a rule, scars are no longer visible by 6 months to 1 year after surgery. A visible midline scar can be revised with the broken-

line technique or dispersed with a primary Z-plasty (Figs. 2.8b and 2.15; Fig. 4.3b). Smaller defects can be managed with a Burow's U-advancement on one side (Fig. 4.3a).

Double Rotation Flap

(Fig. 4.4)

A double rotation flap can be used to close larger midline and paramedian defects in the forehead. Again, the scars are located principally along the eyebrow and hairline (Fig. 4.4b).

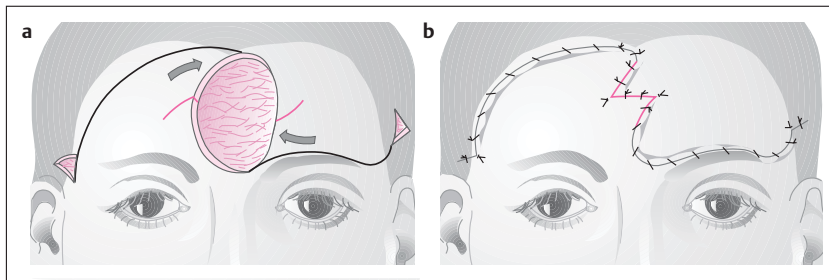


Fig. 4.4 **Double rotation flap.**

- a, b** An elliptical forehead defect is covered by incising and rotating the forehead skin and closing all defects. Again, a Z-plasty can be used to disperse the scar.

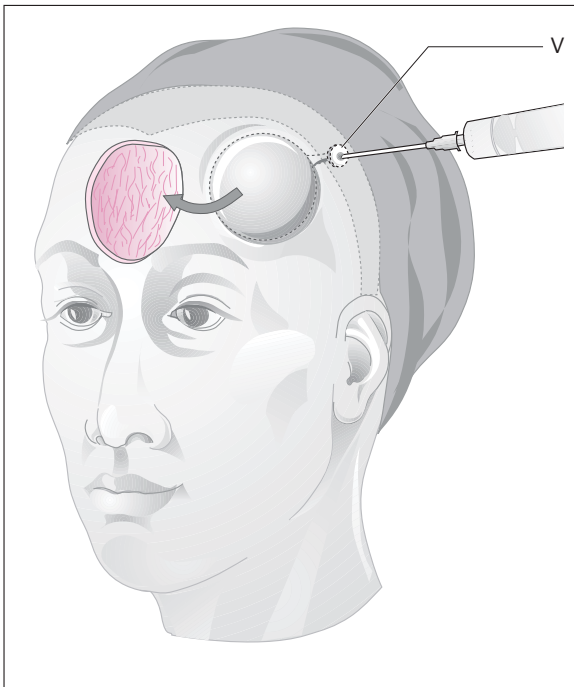


Fig. 4.5 Use of a **tissue expander** with a volume of approximately 100 cm³. V = valve for injecting sterile saline solution into the expander.

Soft-tissue expansion can also be used for the primary closure of large midline defects (Fig. 4.5).

Lateral Forehead Defects

Forehead Rotation

(Fig. 4.6)

A wedge-shaped lateral forehead defect can be closed by making a long incision behind the frontal hairline, widely mobilizing the forehead skin, and rotating the skin into the defect. A dog ear is excised at the pivot point in the central forehead, and the wound is closed (Fig. 4.6b).

Similarly, wedge-shaped defects in the lateral forehead can be covered by a modification of the Esser cheek rotation flap (Fig. 4.7). Burow's triangles are excised below the earlobe and on the neck to close the secondary defect. In the area of the zygomatic arch, the flap should be carefully dissected on the subcutaneous plane to avoid damaging the temporal branch of the facial nerve, which is very superficial in that area.

Other options for covering lateral forehead defects are described in the section on reconstructing cheek defects (see Figs. 8.10, 8.16, 8.19, 8.22, and 8.24).

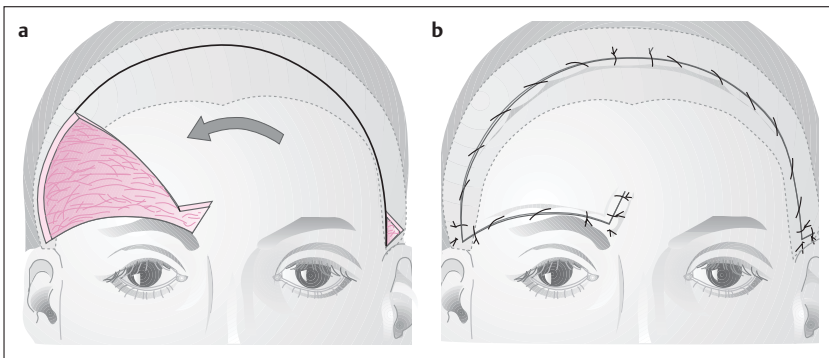


Fig. 4.6 Lateral forehead defect closed with a **rotation flap**.

- a The flap incision is placed approximately 3–4 cm behind the hairline.
- b The primary defect is closed. A Burow's triangle is excised at the pivot point (this may be postponed due to risk of flap necrosis).

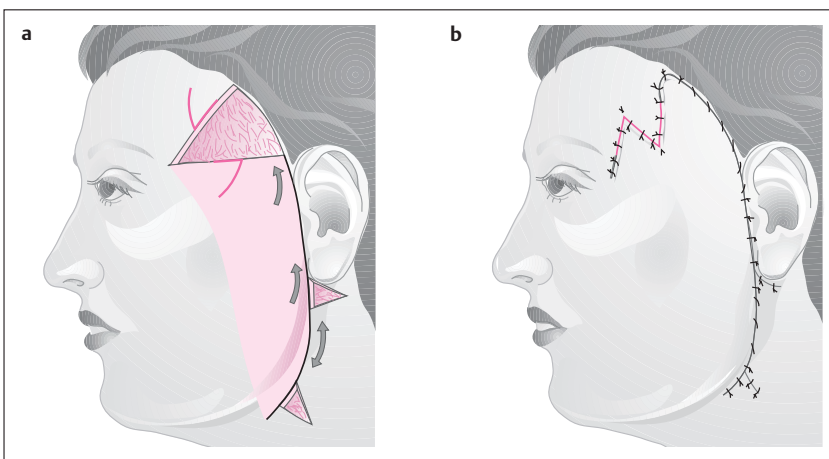


Fig. 4.7 Lateral forehead defect closed with an **Esser cheek rotation flap**.

- a Cheek rotation with Burow's triangles.
- b Closure of all defects. Z-plasty (red line) can be added to disperse the scar.

5 Nasal Region

The reader is advised at this point to review the esthetic units of the nose (see p. 9 and Fig. 2.20b, c).

Glabella and Nasal Root

(Figs. 5.1–5.9)

U-Advancement Flap of Burow

(Fig. 5.1)

A simple U-shaped advancement flap can be used to cover smaller defects in the area of the glabella and upper nasal dorsum (see p. 12). Burow's triangles are excised just above the eyebrow, resulting in unobtrusive scars.

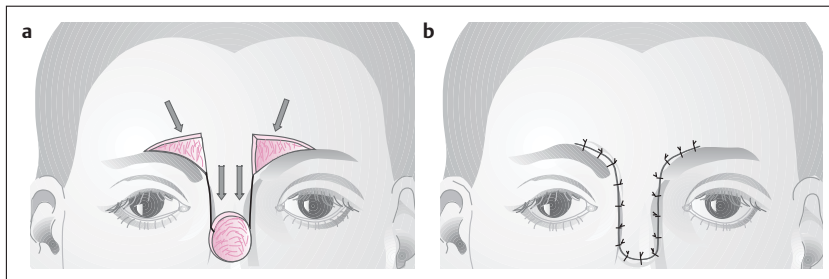


Fig. 5.1 **U-advancement flap** from the glabella, used to reconstruct a defect in the superior nasal dorsum.

- a** Burow's triangles are located just above the eyebrows.
- b** Appearance after closure of all defects.

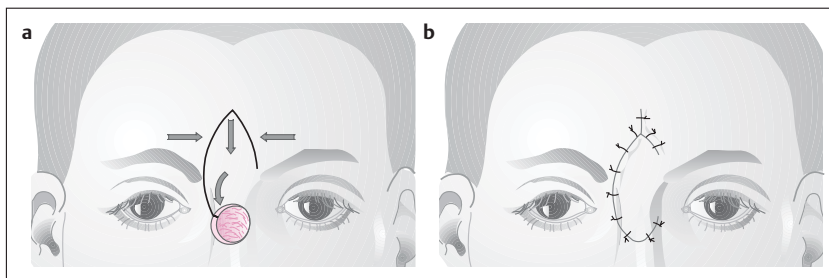
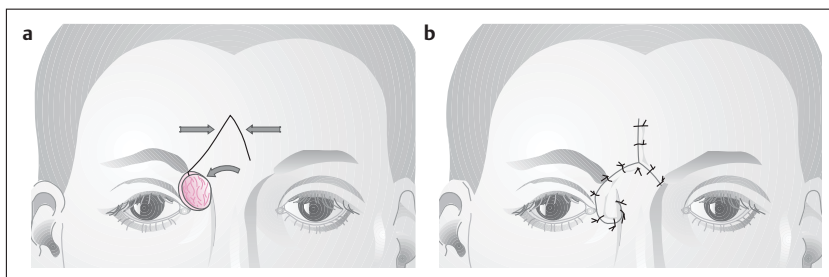


Fig. 5.2a, b **Trapezoidal V-Y advancement.**



Figs. 5.3a, b and 5.4a, b **Modifications of the V-Y advancement.**

V-Y Advancement

(Fig. 5.2)

Trapezoidal rotation flaps are useful for reconstructing defects of the upper nasal dorsum (Fig. 5.2a) and canthal area (Figs. 5.3–5.6). The flap geometry corresponds to a V-Y advancement, and the secondary defect is closed by mobilizing the surrounding skin (Figs. 5.2b, 5.3, and 5.4). Because these flaps receive a good blood supply from the supratrochlear artery on one side, the pedicle can be kept relatively thin, allowing for good mobilization and downward rotation of the flap.

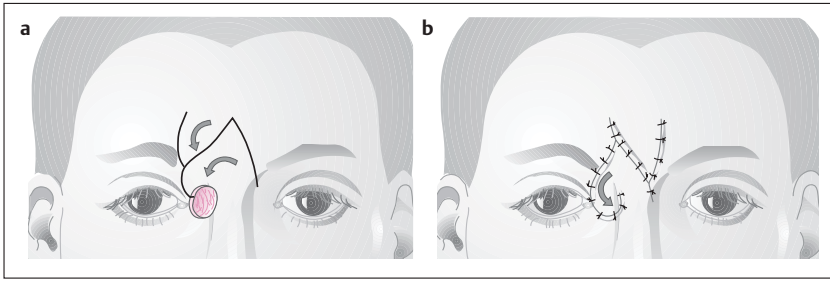


Fig. 5.4 a, b V-Y advancement with a Z-plasty.

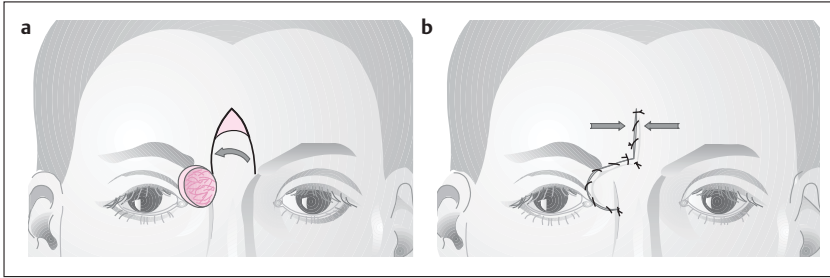


Fig. 5.5 a, b Closure with a small transposition flap.

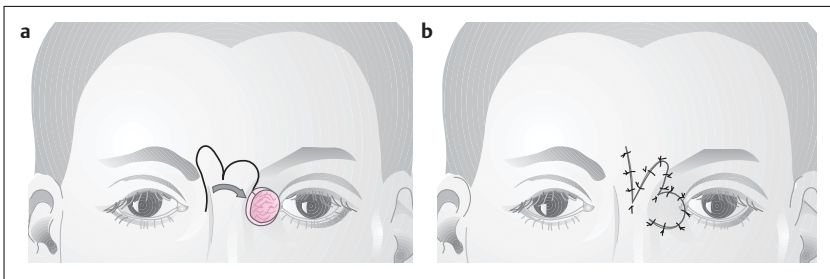


Fig. 5.6 a, b Closure with a bilobed flap.

Sliding Flap

(Fig. 5.7)

The sliding flap of Barron and Emmet (1965), which has a lateral subcutaneous pedicle (see p. 13 and Figs. 3.11–3.14), has proven useful for reconstructing de-

fects located more in the upper lateral portion of the nasal bridge. Besides a simple transposition flap (Fig. 5.5), a specially designed V-Y advancement flap (Fig. 5.3) or V-Y advancement with a Z-plasty (Fig. 5.4) can be used.

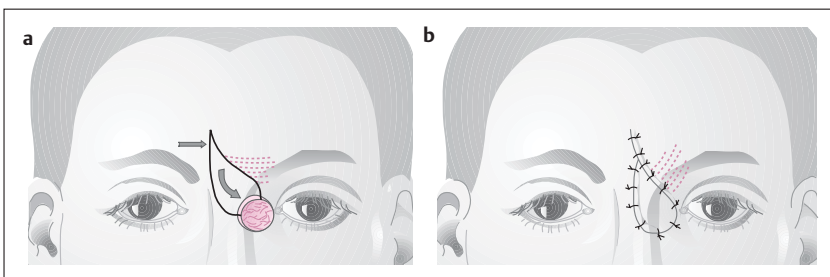


Fig. 5.7 **Sliding flap** with a lateral subcutaneous pedicle.
a Outlining the flap.
b Closure of all defects.

Nasal Dorsum

(Figs. 5.8–5.12)

Because the skin of the nasal dorsum is very tight, only relatively small defects extending across the dorsum can be closed by mobilizing the surrounding skin. A great many defects in this area can be closed with local tissue transferred from above or from the side. It should be noted, however, that the skin of the cheek and forehead is considerably thicker than the dorsal nasal skin.

Bilobed Flap

(Fig. 5.8)

Superiorly or inferiorly based bilobed flaps have proven excellent for the reconstruction of defects in the nasal dorsum and sidewall (see p. 16 and Fig. 3.23). Both small and larger defects can be managed in this way. The first lobe of the flap is moved into the primary defect, the second lobe is moved into the defect created by the first lobe, and the other secondary defect is closed with a small cheek flap. The angle be-

tween the primary defect and first lobe should approximately equal the angle between the first and second lobes, and all the angles should be 90° or less if possible. Larger angles lead to greater torsion and a bulkier dog ear at the pivot point of the flap (see p. 16 and Figs. 3.22 and 3.23). If the transfer creates a relatively large cheek defect, care should be taken that the closure does not distort the lower eyelid. For this reason, the subcutaneous tissue of the lower wound margin is usually attached to the periosteum of the upper wound margin after the cheek has been mobilized.

Island Flap

(Fig. 5.9)

The island flap described by Converse (1977), based on **one or both** trochlear arteries, is also useful for reconstructing defects in the nasal dorsum (Fig. 5.9). The bridge of skin between the island flap and the primary defect can be partially or completely divided if the flap shows livid discoloration due to excessive pressure on the pedicle.

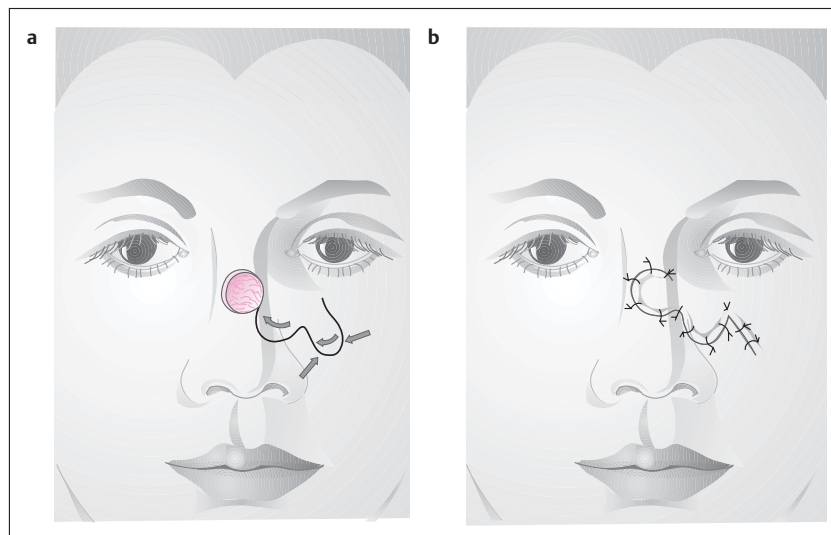


Fig. 5.8 **a** Outlining a superiorly or inferiorly based **bilobed flap**. **b** Closure of all defects. (Distortion of the lower eyelid should be avoided!)

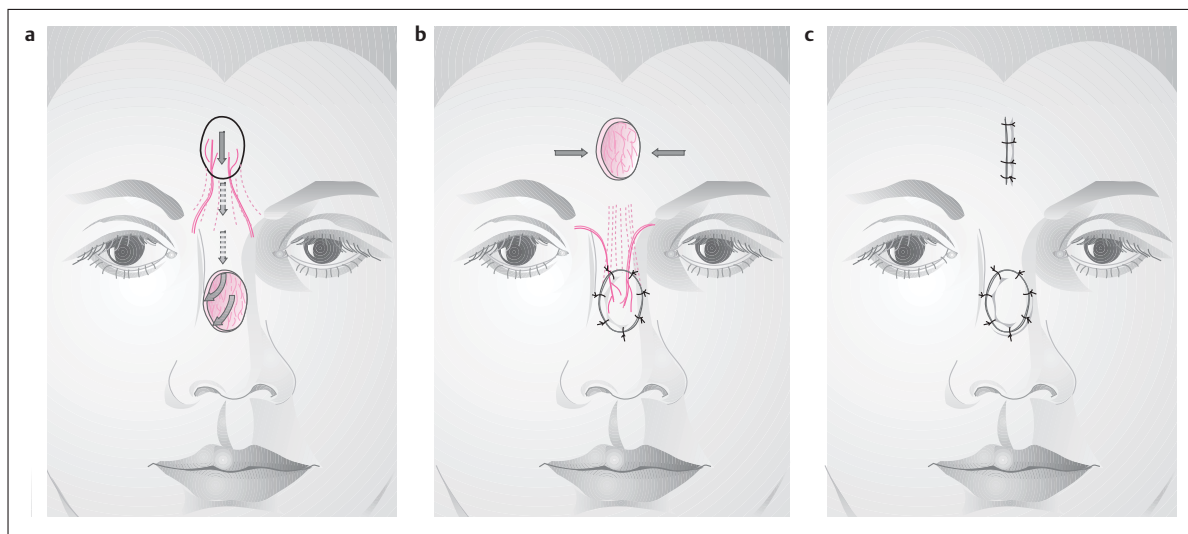


Fig. 5.9 **Island flap** based on the supratrochlear artery (Converse 1977).

- a The flap is outlined, and subcutaneous dissection is performed without vascular injury.
- b The bridge of skin between the flap and defect is undermined, and the island flap is pulled through.
- c Closure of all defects.

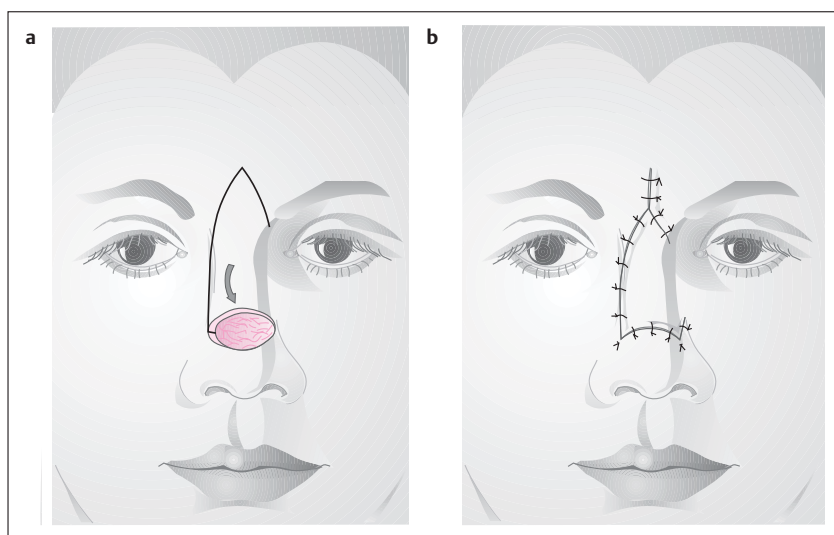


Fig. 5.10 **Trapezoidal V-Y advancement** of Rieger (can also reach the nasal tip; see Fig. 5.14).

Rieger Flap

(Fig. 5.10)

The trapezoidal Rieger flap (Fig. 5.10) is another option for reconstructing dorsal nasal defects (see also Fig. 5.1).

Nasolabial Flap

(Fig. 5.11)

Cameron (1975) suggested using two nasolabial flaps to reconstruct full-thickness nasal defects. The first flap (Fig. 5.11a, b) is swung into the defect with the epithelial side inward, after first removing the epithelium from the area that will overlie the sep-

tum. The second flap is then used for cover (Fig. 5.11c). One nasolabial flap is sufficient for reconstructing a two-layer defect.

Cheek Flap

(Fig. 5.12)

If a large defect of the nasal dorsum cannot be adequately covered with a midline Rieger flap (see Fig. 5.10), it may be necessary to perform a unilateral or bilateral cheek advancement (Fig. 5.12) with Burow's triangles in the nasolabial folds. A better scar is obtained by adding a Z-plasty on the nasal dorsum (Fig. 5.12a, b). The median forehead flap is also useful for this type of reconstruction (see p. 33, Fig. 5.15).

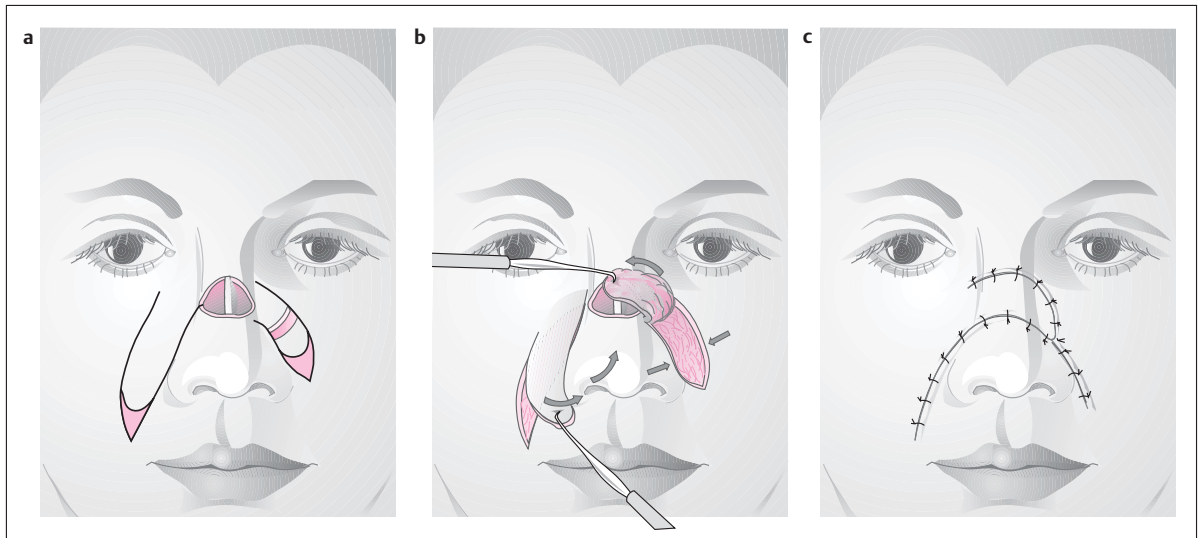


Fig. 5.11 **Nasolabial flaps** (Cameron 1975) used to reconstruct a full-thickness defect.

a One nasolabial flap (left side) is de-epithelialized in the septal area to reconstruct the lining.

b A second nasolabial flap (right) is used for cover.

c Closure of all defects.

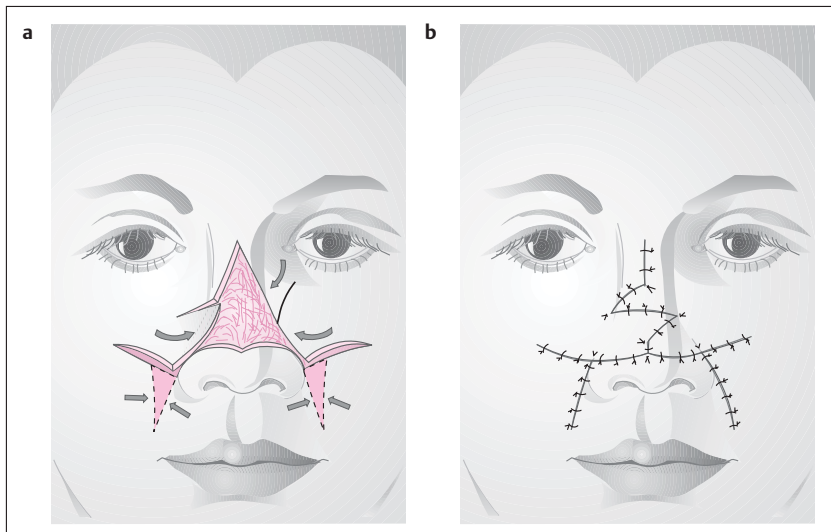


Fig. 5.12 **Two cheek rotation flaps** used to reconstruct a two-layer defect of the nasal dorsum (Cameron 1975).

a The flap is raised, and two Burow's triangles are excised in the nasolabial fold.

b All the wounds are closed. A dorsal Z-plasty can be added to place the scars in the RSTLs.

Nasal Tip

(Figs. 5.13–5.17)

While small defects in the nasal tip area can be reconstructed with local flap transfers, larger defects that extend to the ala and columella require the use of median forehead flaps or the relatively difficult frontotemporal flap described by Schmid and Meyer (1962).

Bilobed Flap

(Fig. 5.13)

The nasal tip area can be reconstructed using bilobed flaps that are based inferiorly (Fig. 5.13a), laterally (Fig. 5.13c), or superiorly (Fig. 5.13e). The scars should be placed approximately in the RSTLs. If the flaps are sufficiently large and mobile, a defect in the upper columella can be repaired concurrently with the tip defect.

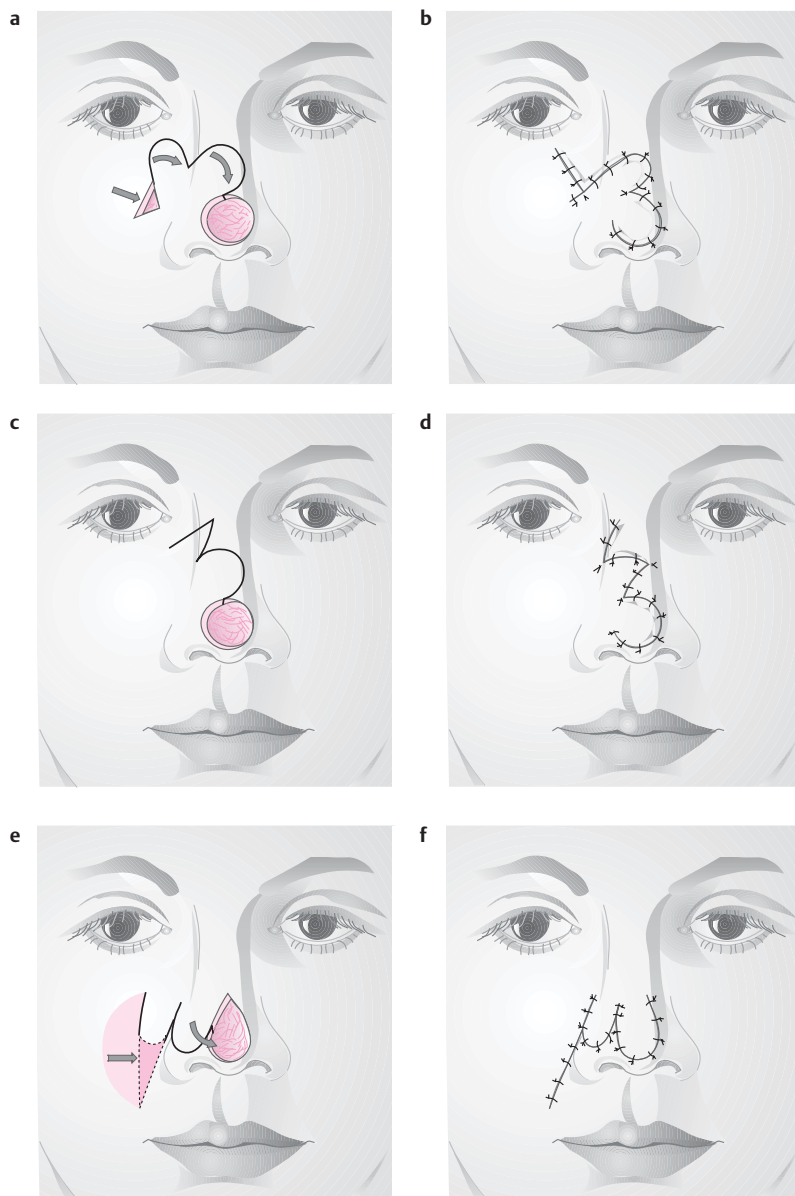


Fig. 5.13 a–f Various designs of the **bilobed flap**.

V-Y Advancement Flap of Rieger (1957)

(Fig. 5.14)

Larger nasal tip defects can be covered with a Rieger advancement flap based on the side of the nose (Fig. 5.14a). The glabellar portion of the flap has a

trapezoidal design. The flap is mobilized along the opposite nasal flank, and a V-Y advancement is performed (Fig. 5.14b). A small Z-plasty may be necessary with larger defects (Fig. 4.14c, d). The U-advancement is another option (Fig. 5.14e, f).

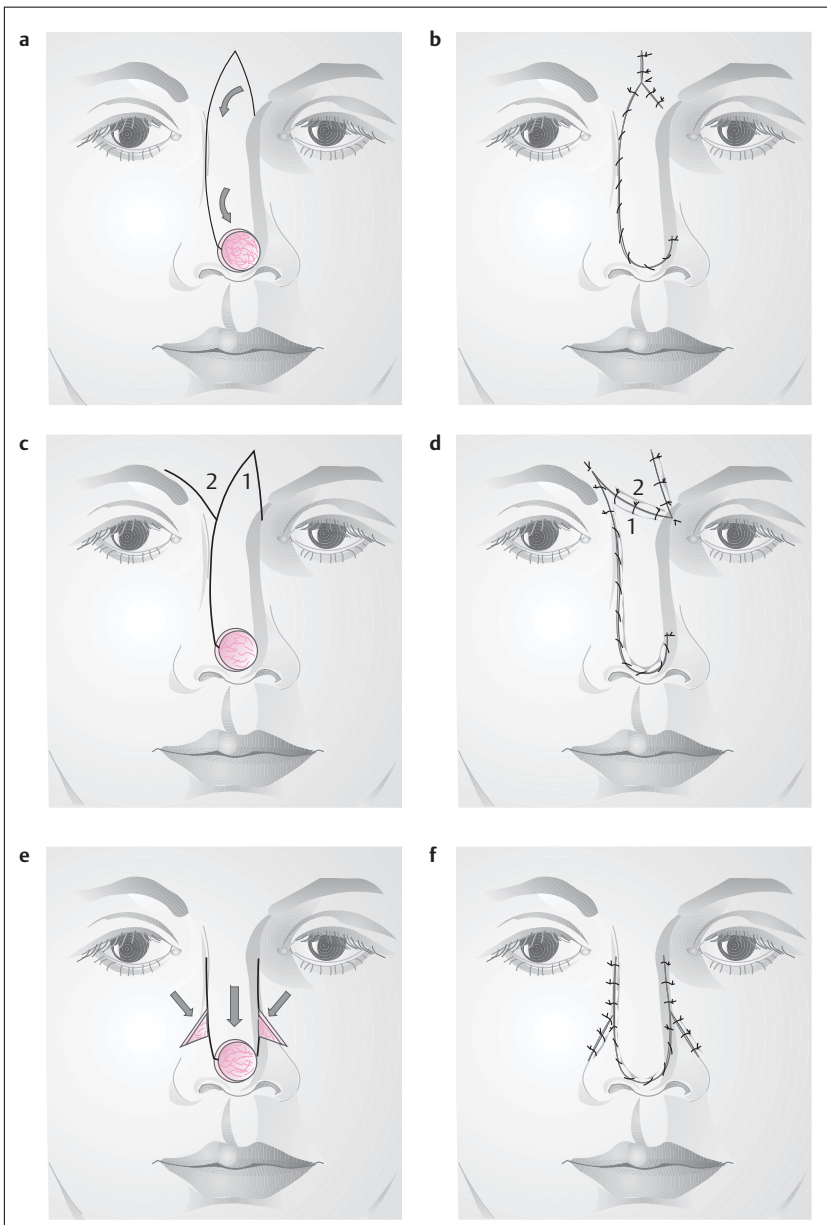


Fig. 5.14 Various designs of advancement flaps used to reconstruct the dorsal nasal skin. a–d Long Rieger flap (see Fig. 5.10). e, f U-shaped advancement.

Median Forehead Flap

(Fig. 5.15)

The median forehead flap is used to reconstruct larger defects of the nasal dorsum, sidewall, and tip. The flap receives its blood supply from the supratrochlear artery on **one or both sides** (Fig. 5.15b). These vessels can be identified with a Doppler probe. The forehead should be high enough to permit the end of the flap to reach the nasal tip (using a pattern as a guide). The width of the flap should not exceed 3–3.5 cm so that the donor defect in the forehead can be closed primarily without special preparations. The flap can be used immediately owing to its excellent blood supply. The medial vertical scar in the forehead can be dispersed with a primary Z-plasty or W-plasty (see pp. 6 and 8). If the flap is broad resulting in a tense suture line, we prefer secondary revision of scars that are still conspicuous 1 year after the operation.

The flap incision can be made through all layers down to the level of the eyebrow (Fig. 5.15a). In the glabellar area, the flap is bluntly dissected with a sponge stick or curved clamp to expose and preserve the artery on one or both sides (Fig. 5.15b). The skin incision can then be continued down below the brow level. If one artery is lost, the second artery generally can ensure adequate flap perfusion. The residual triangular defect in the interbrow area (Fig. 5.15c) is covered with meshed tulle or a similar dressing. About 17–20 days are needed for the forehead flap to take at the recipient site (Fig. 5.15d). At that time its pedicle is divided and inset into the triangular interbrow defect, which is first cleared of granulation tissue (Fig. 5.15d). The interbrow wound should not be reapproximated at the time of flap transfer, as this would distort the eyebrows by drawing them toward the midline. The wound edges should be freshened prior to inset of the flap pedicle.

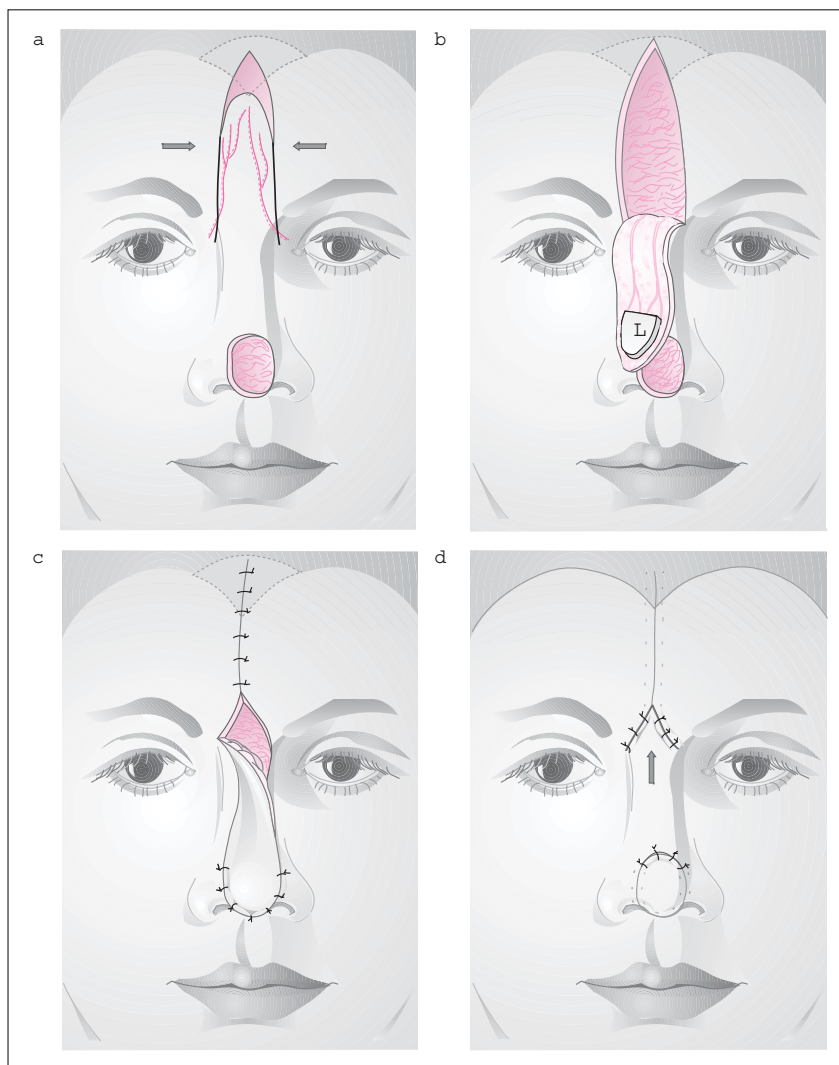


Fig. 5.15 Median forehead flap.

- Outline of the median forehead flap, which is based on **one or both** supratrochlear arteries. The maximum flap width is 3.5 cm.
- The flap is dissected, leaving the galea and periosteum on the bone. If necessary, a split-thickness or full-thickness skin graft or composite graft (L) can be attached to the distal end of the flap.
- The flap is sutured into the tip defect and the forehead wound is closed, leaving a wedge-shaped defect between the eyebrows.
- The flap has been detached and its inset completed. The pedicle is reimplanted in the interbrow area 3–4 weeks later. (see Fig. 5.16d)

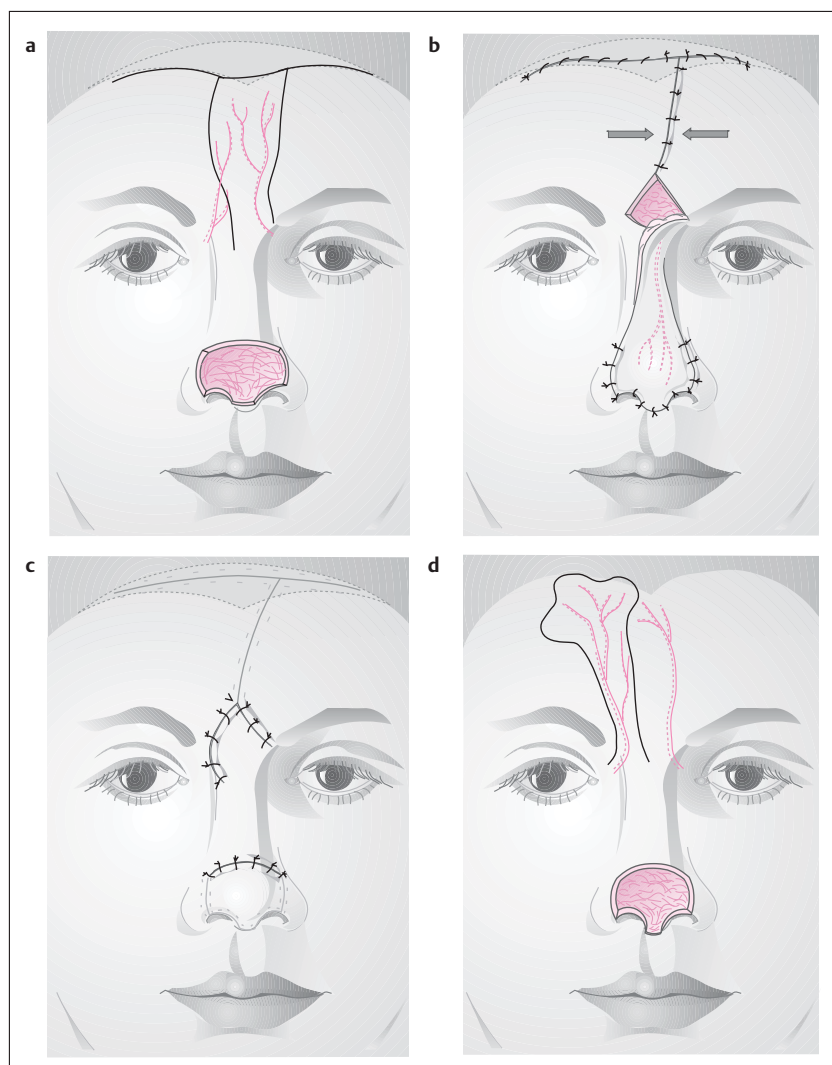


Fig. 5.16 **Straight and oblique forehead flaps** of varying sizes.

- a** Paramedian forehead flap based on one supratrochlear artery.
- b** Closure of the defects.
- c** About 20 days later the flap is detached and the pedicle returned (see Fig. 5.15).
- d** Oblique forehead flap. The flap width may exceed 3.5 cm, but this precludes a simple direct closure of the secondary defect (see Figs. 4.2–4.5).

As in all operations, meticulous hemostasis is required.

The flap takes from 6 months to 1 year to heal completely. If it is too thick or if unsightly scars have formed, the flap may be thinned (defatted) and/or the scars revised by means of small Z-plasties or W-plasties (see pp. 6, 8). For larger defects, we recommend using 50–100-mL tissue expanders on one or both sides (see Fig. 4.5) before raising the median or oblique forehead flap.

Modifications are asymmetric, paramedian forehead flaps (Fig. 5.16a–c) and oblique forehead flaps (Fig. 5.16d).

Larger Defects of the Nasal Tip and Ala

Frontotemporal Flap of Schmid and Meyer

(Figs. 5.17 and 5.18)

If the median or oblique forehead flap cannot adequately cover a defect or if larger, full-thickness defects are present, excellent results can be achieved with the somewhat difficult frontotemporal flap of Schmid (1952) as modified by Meyer (1964, 1988) (Fig. 5.17). Because of its technical complexities, however, this flap is no longer widely used.

The flap is mobilized in stages approximately 16–20 days apart. In about 8 weeks the surgeon can swing the flap downward, freshen the wound edges, and inset the flap into the defect.

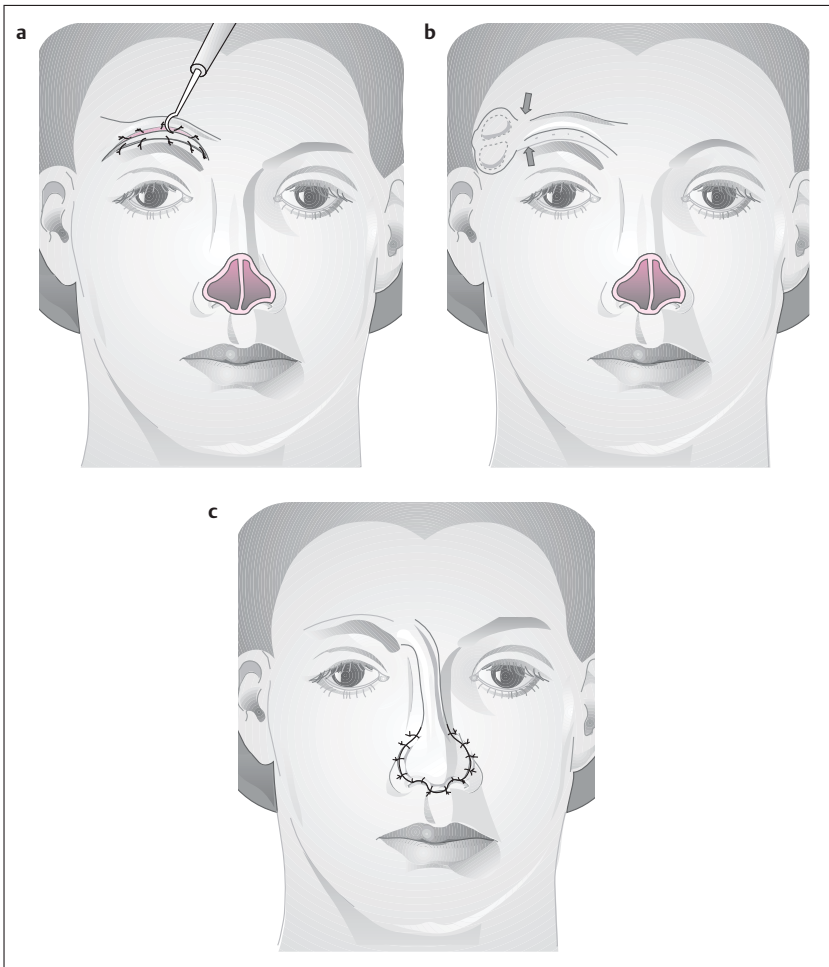


Fig. 5.17 Frontotemporal flap of Schmid and Meyer (1964).

- a** A narrow bipedicle flap is raised above the eyebrow to function as a “transport flap.” The cut is widened slightly toward the bone. The defect is closed primarily, tacking the upper wound edge to the frontal periosteum to avoid drawing the eyebrow upward. The bipedicle flap is sheathed with split-thickness skin. The reconstructive flap is outlined in the temporal area using a pattern.
- b** A small bridge of skin (arrows) is left between the temporal flap and the bipedicle flap.
- c** About 6–7 weeks after creating the bipedicle flap and 3 weeks after dividing the small bridge between the two flaps, the temporal flap is transferred and inset into the nasal defect. About 3–4 weeks later the nutrient pedicle is detached at the nasal tip. If the tubed flap will be used to reconstruct the columella, the pedicle is divided at the eyebrow.

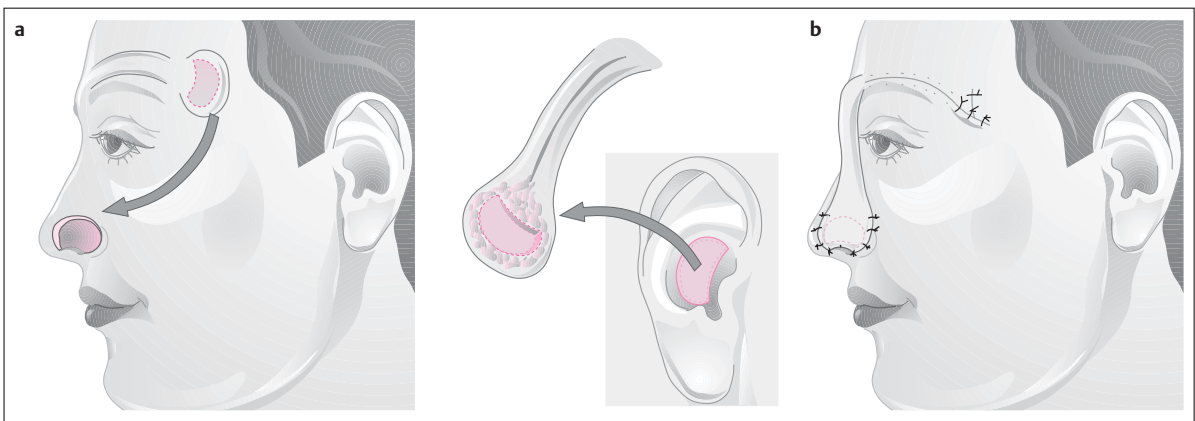


Fig. 5.18 **a** The frontotemporal flap is pre-cut, and its temporal end is lined with a composite graft.
b The flap is inset into the alar defect.

Stage I: First a narrow, superciliary bipedicle flap is created. The flap incisions above the eyebrow should be spaced at a width of no more than 8 mm, but the lateral ends can be angled superiorly and inferiorly in a trapezoidal design. The superciliary defect below the bipedicle flap is closed by mobilizing the fore-

head skin (Fig. 5.17a). The upper edge of the wound is tacked subcutaneously to the periosteum of the frontal bone to prevent eyebrow distortion. The superciliary segment of the flap is then sheathed with a split-thickness skin graft. The bipedicle flap serves merely as a transport flap; the reconstructive flap is outlined

in the temporal area to conform to the nasal defect (Fig. 5.17b). Split-thickness skin, cartilage, or composite grafts can be added to the temporal flap during the initial sitting (Fig. 5.18).

Stage II: About 15–20 days later, the bridge between the prelined temporal flap and the transport flap is incised (Fig. 5.17b).

Stage III: After a total of 3–4 weeks the entire flap can be raised on its median pedicle, and the temporal flap is inset into the nasal defect (Fig. 5.17c).

Stage IV: About 3–4 weeks later the pedicle can be divided or opened up, inset to reconstruct the columella (Meyer 1988), or discarded.

Additional stages: Further steps may be needed to complete the inseting of the temporal flap in the nose, or scar revisions may be necessary to improve the outcome. This technique can also be used for alar reconstruction using a composite graft from the auricular concha (Fig. 5.18). Other flap options for partial nasal reconstruction are described on pages 47–51

Nasal Flank

We use small **transposition or rotation flaps** from the cheek to reconstruct defects of the nasal flank (Figs. 5.19–5.21).

Below we shall illustrate some special flap designs that can be used when the flaps described above are inadequate for reconstruction.

Flap Advancement of Burow (1855)

(Fig. 5.22).

Wedge-shaped defects in the nasal sidewall can be closed using a simple Burow's advancement flap. The scars run along the nose at the boundary of the esthetic unit (see Fig. 2.20) and in the nasolabial fold.

Median Cheek Rotation of Sercer (1962)

(Fig. 5.23)

Rotating the cheek medially on a superiorly based flap results in scars at the boundary of the esthetic units.

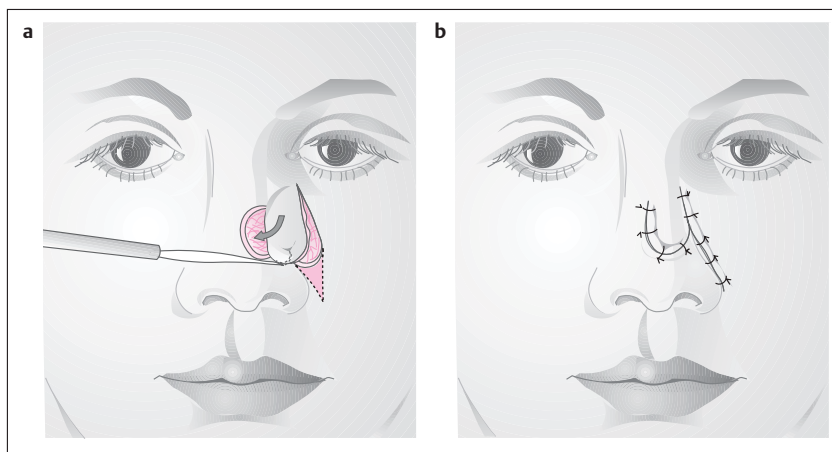


Fig. 5.19a, b Superiorly based lateral transposition flap.

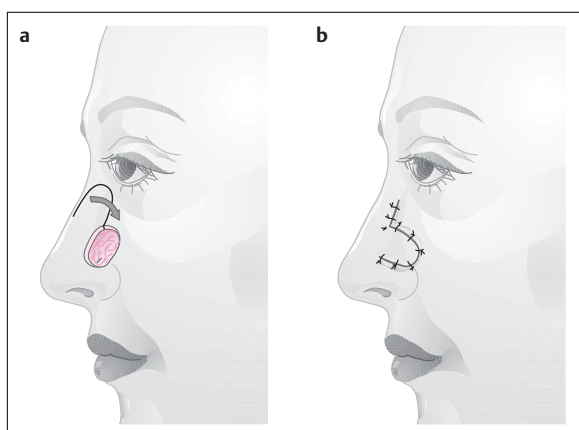


Fig. 5.20a, b Small transposition flap based inferomedially.

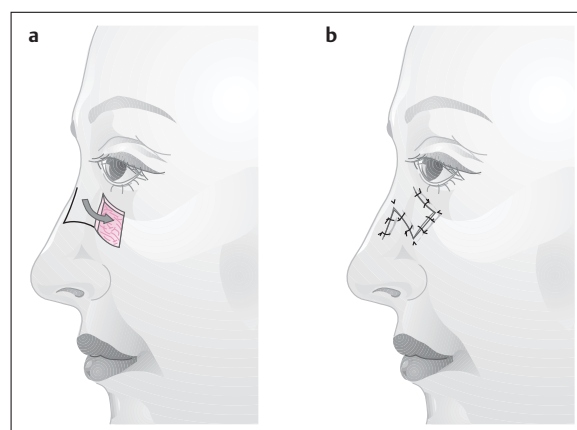


Fig. 5.21a, b Small Limberg flap.

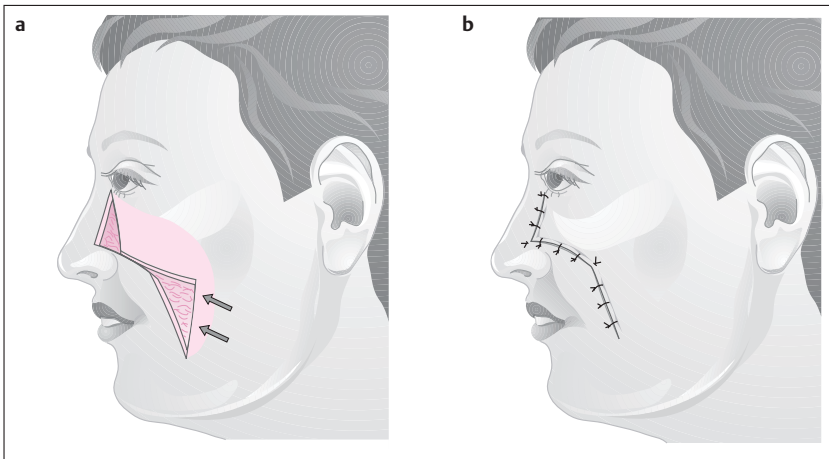


Fig. 5.22 **Burow's advancement flap.**

- a** Wedge-shaped defect on the nasal flank. Burow's triangle is in the nasolabial fold.
- b** Closure of all defects (see Fig. 3.1).

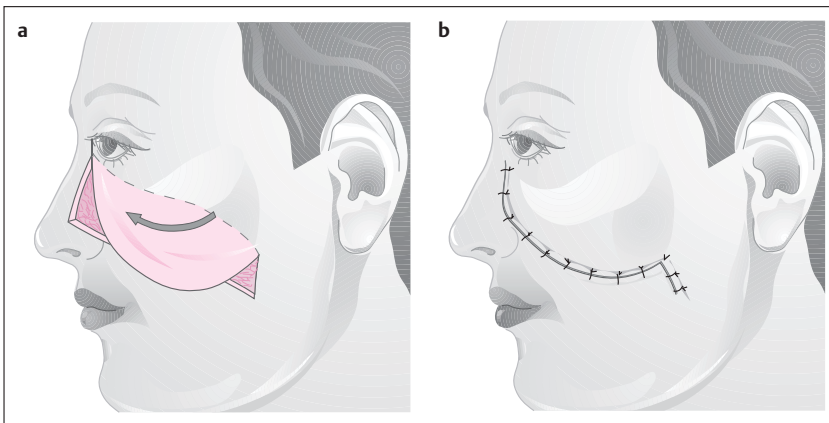


Fig. 5.23 Superiorly based **cheek rotation** of Sercer (1962).

Burow's Laterally Based Cheek Advancement Flap

(Fig. 5.24; see also Fig. 3.1)

Imre's Cheek Rotation (1928)

(Fig. 5.25)

Imre developed a laterally based, wedge-shaped cheek rotation flap for reconstructing nasal flank defects that extend into the lower eyelid. Instead of a Burow's triangle, a banana-shaped incision is made

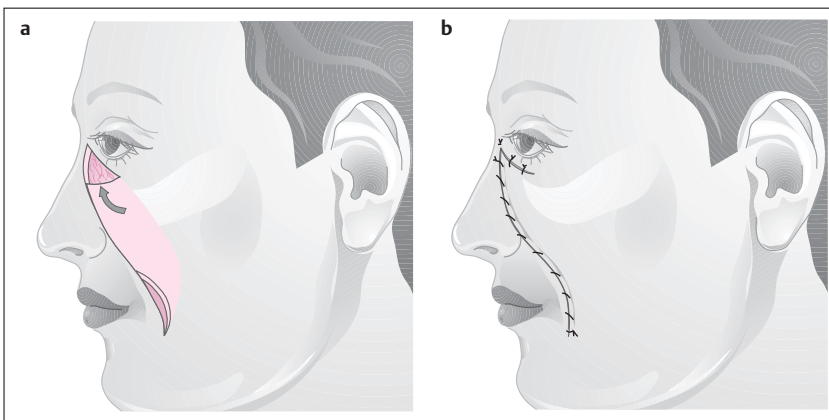


Fig. 5.24 **a, b** Burow's laterally based **cheek advancement** is a hook-shaped flap for repairing nasal flank defects (also suitable for lower eyelid reconstruction).

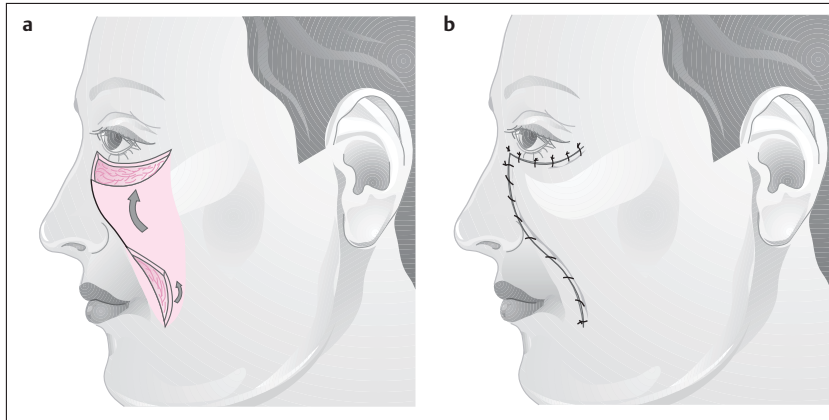


Fig. 5.25 **Cheek rotation** of Imre (1928) with a banana-shaped skin excision.

- a** Flaps outlined for reconstructing the lower eyelid.
- b** Closure of all defects (subcutaneous tissue is fixed to the orbital periosteum).

in the nasolabial fold. The subcutaneous tissue of this flap should be fixed to the periosteum of the orbital margin to prevent eversion of the lower eyelid. For the same reason, the flap should not be sutured under tension.

Cheek U-Flap (Fig. 5.26)

This flap is rarely used because it conforms poorly to the RSTLs, especially in its superior portion. It can be used in cases of tumor recurrence involving the nasal flank and medial canthal area, especially if median forehead flaps have already been used. Banana-

shaped excisions can be made at the end of the flap instead of Burow's triangles. One alternative to the U-flap is the Esser-Imre cheek advancement (see Fig. 8.2).

Figures 5.27–5.31 illustrate several practical flap techniques that can be used to reconstruct smaller defects throughout the nasal region:

- The double Dufourmental flap (Fig. 5.27), well suited for reconstructing smaller defects,
- The bilobed flap (Figs. 5.28 and 5.29).
- Transposition flaps (see Fig. 5.19).
- Advancement flaps (Fig. 5.30).
- Double transposition flaps (Fig. 5.31).

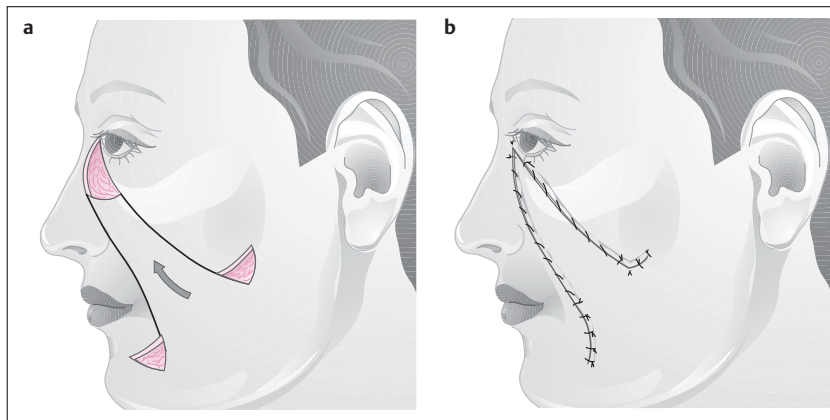
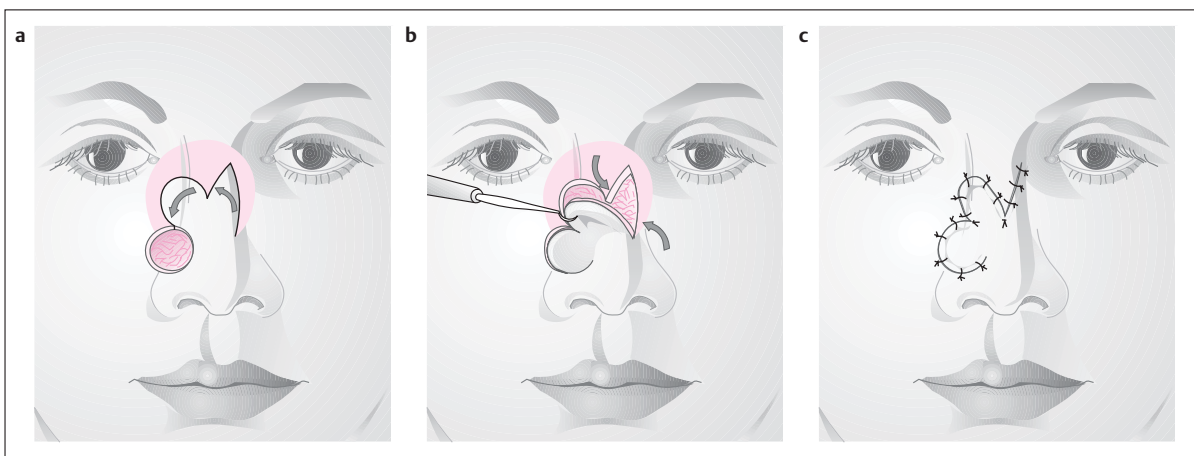
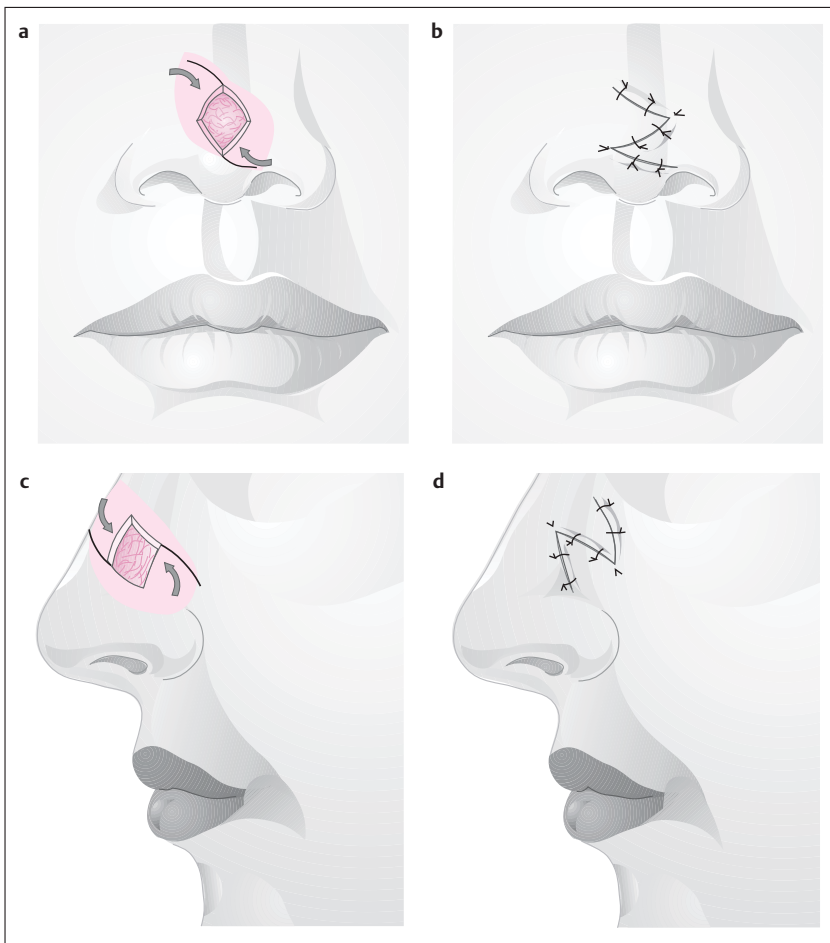


Fig. 5.26 **Cheek U-flap** is rarely used as it runs across the RSTLs.



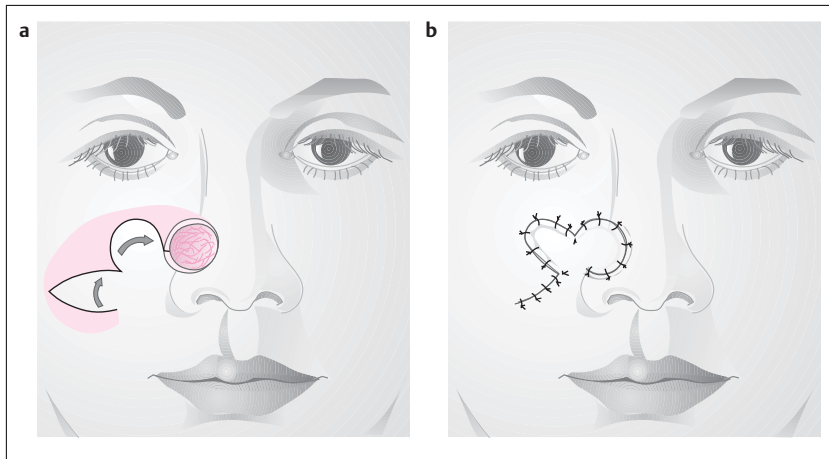


Fig. 5.29a, b Bilobed flap

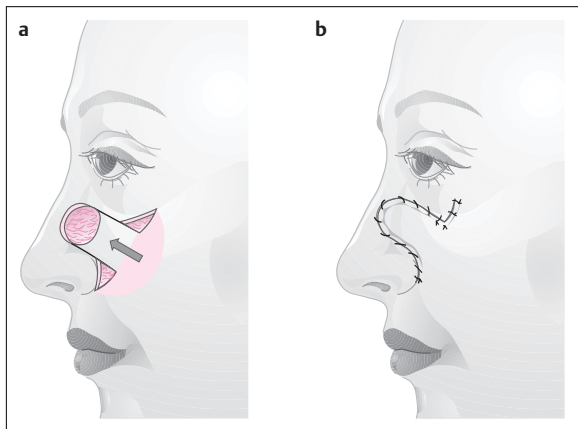


Fig. 5.30a, b U-advancement flap. Burow's triangles are excised from the nasolabial fold and nasal flank.

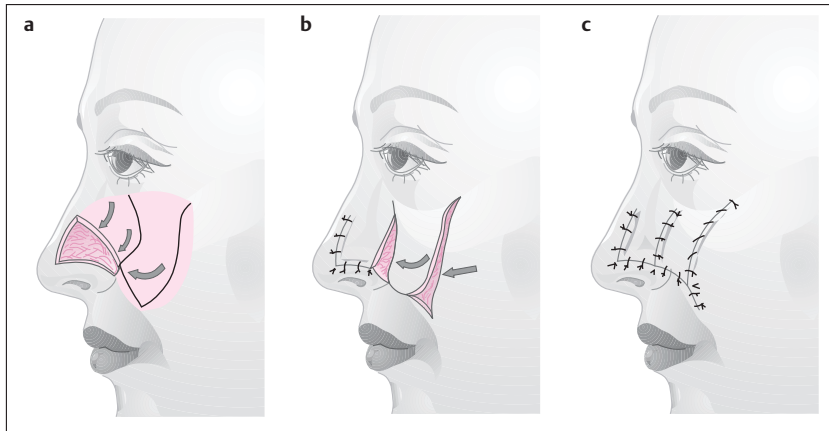


Fig. 5.31a-c Double transposition flap with V-Y advancement.

Island Flap (Fig. 5.32)

An island flap from the cheek is also useful for reconstructing small defects in the nasal flank area. The flap may be based on the facial artery or may be designed with a subcutaneous pedicle that has an inferolateral or superolateral position in relation to the

flap. The skin between the flap and the defect is undermined, and the pedicle is pulled through. Care is taken not to place excessive torsion or pressure on the flap pedicle. Because the subcutaneous pedicle often creates fullness at the pull-through site, this is not one of our favorite flaps. The cheek must be mobilized somewhat more widely than with other flaps to avoid distorting the upper lip.

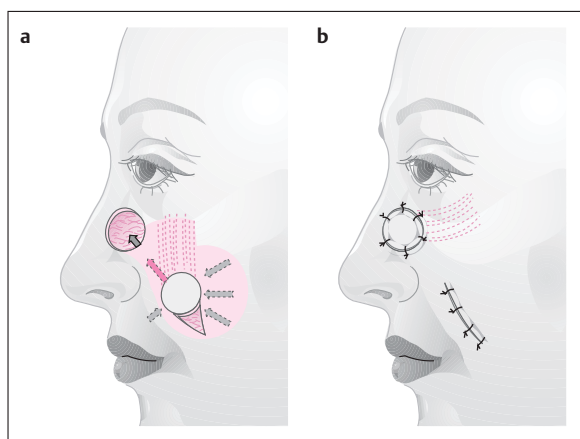


Fig. 5.32 **Island flap on a subcutaneous pedicle.**

- a** The pedicle is undermined (red arrow) to create a tunnel.
b The flap is inset into the defect, and the donor site is closed primarily. (The flap can also be designed as an axial pattern flap based on the facial artery.)

Sliding Flap

A better choice is the sliding flap (Fig. 5.33). A sliding flap from the nasolabial fold is well suited for reconstructing the area where the lower or middle third of the nose meets the cheek. Like the island flap described above, the sliding flap is generally slid into the defect on a lateral pedicle (see Figs. 3.11–3.13) (Barron et al. 1965). Other examples are shown in the chapters on the cheek region (pp. 84) and eyelid region (pp. 95).

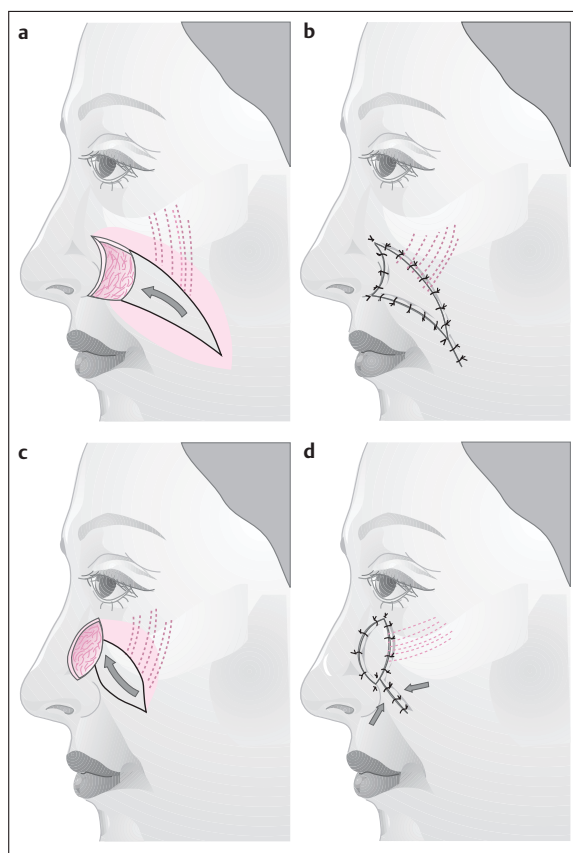


Fig. 5.33 **Sliding flaps** for reconstructing defects behind the ala (**a, b**) or in the lateral nasal wall (**c, d**). These flaps are of variable size and may be transferred on a subcutaneous pedicle (see Fig. 3.12).

Nasal Ala

Smaller alar defects, especially when less than full thickness, can be covered using small rotation and transposition flaps or an island flap (Fig. 5.32; see also Figs. 5.28–5.31).

Full-Thickness Reconstructions

Z-Plasty of Denonvilliers and Joseph (1931) (Fig. 5.34)

A defect in the alar rim can be corrected by mobilizing the ala as a full-thickness flap based on the alar groove and performing a Z-plasty to bring down the superior nasal soft tissues.

Anteriorly Based Alar Rotation (Weerda 1984) (Fig. 5.35)

Our technique differs from Denonvilliers' in that we use a flap based anteriorly on the nasal tip to bring down the alar rim. This allows us to place the Z-plasty more in the area of the nasolabial fold and

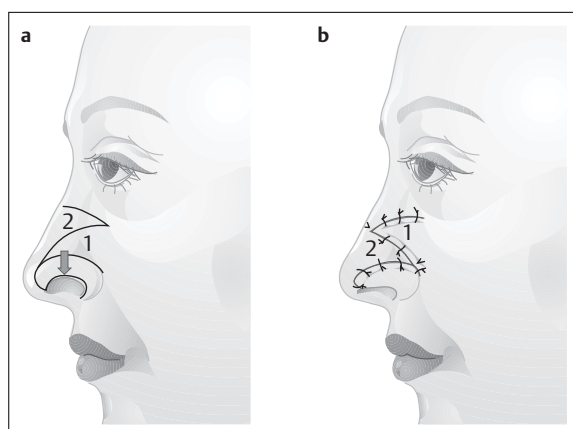


Fig. 5.34 **Z-plasty** of Denonvilliers and Joseph (1931).

- a** Laterally and medially based flaps (1, 2) are transposed to bring down the alar rim.
b Closure of all defects.

cheek, where the skin is generally more mobile. The somewhat thicker cheek skin must be adequately thinned, and secondary refinement of the alar rim may be necessary at a later time.

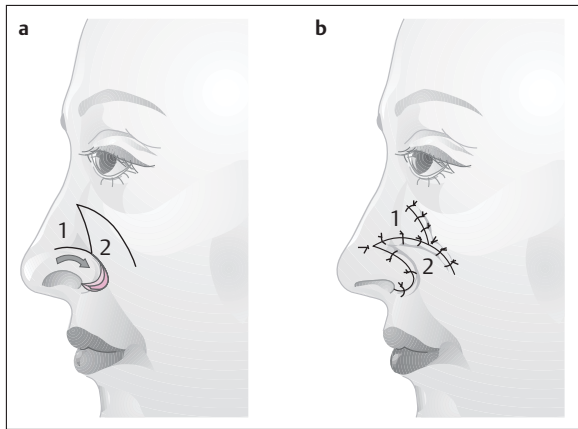


Fig. 5.35 **a** Anteriorly based **alar rotation** of Weerda (1984).
b All defects are covered with a Z-plasty.

Modification of the Anteriorly Based Alar Rotation

The defect formed by downward rotation of the ala can also be closed with a small, superiorly based transposition flap from the adjacent region (Fig. 5.36a–c).

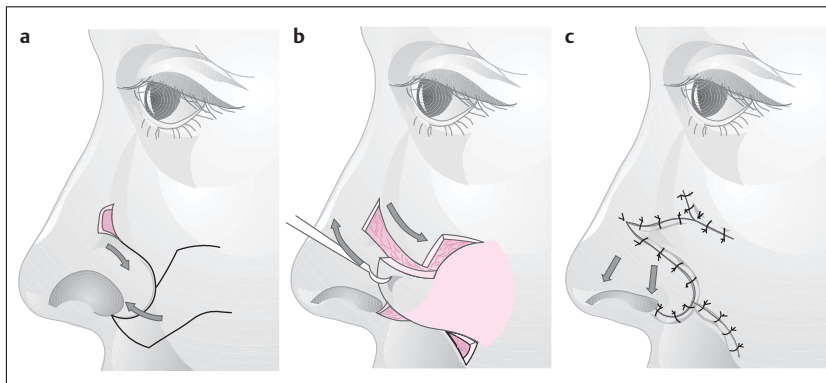


Fig. 5.36 Modification of the anteriorly based **alar rotation**.
a An incision is made around the ala, and two adjacent flaps are outlined.
b The ala is brought down to the desired position, and the flaps are transposed.
c Appearance after the reconstruction.

Coverage with a Transposition Flap

A turnover flap is outlined in the skin above the alar rim defect and turned down to reconstruct the nostril lining (Fig. 5.37a). A laterally based transposition flap is then raised from the cheek and nasolabial fold to cover the partial-thickness defect (Fig. 5.37b, c).

Lowering the Alar Rim as a Full-Thickness Bipedicled Flap and with a Composite Graft (Fig. 5.38)

The alar rim can also be lowered by making a full-thickness incision approximately 7–8 mm above and parallel to the alar rim (Fig. 5.38a). After the ala has been brought down, the secondary defect is repaired with a three-layer composite graft from the auricle (see also p. 11 and Fig. 2.23).

Turnover Flap and Composite Graft (Lexter 1931, modified by Kastenbauer 1977)

A bipedicled turnover flap is used for intranasal lining (Fig. 5.39a, b), similar to the technique just described. Then a two-layer composite graft is used to reconstruct the alar rim. The skin of the composite

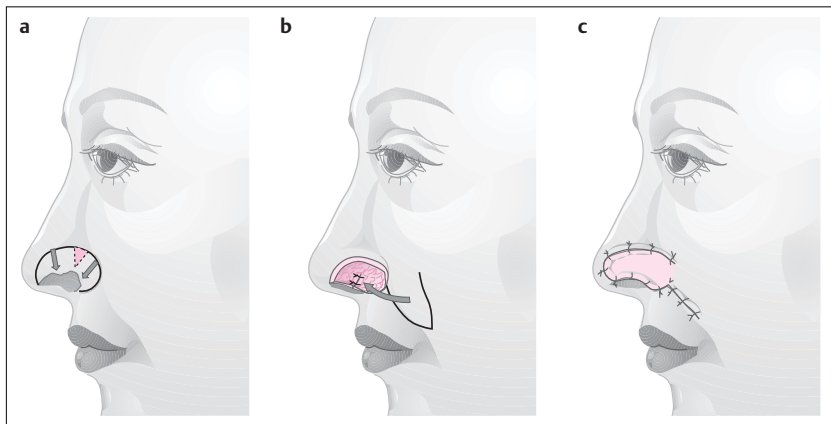


Fig. 5.37 Reconstruction of the ala using a **turnover flap** and a transposition flap from the nasolabial fold.
a The turnover flap for lining the defect is outlined, excising a small triangular skin flap as needed.
b Lining of the defect is completed, and the transposition flap is raised.
c Appearance after the reconstruction. (Additional inset of the pedicle may be necessary.)

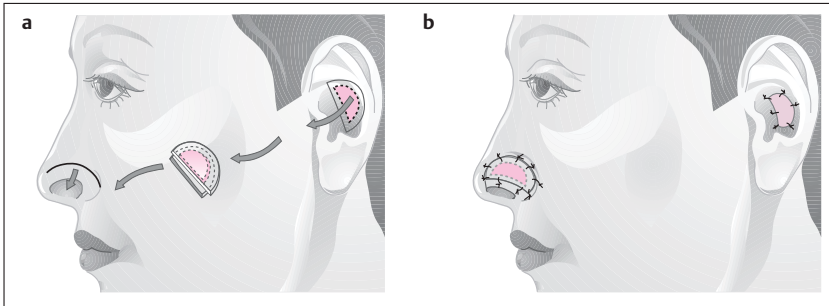


Fig. 5.38 Lowering the alar rim with a full-thickness bipedicle flap and closing the defect with a full-thickness auricular composite graft (see Fig. 2.23).

- a A full-thickness incision is made around the ala, the rim is lowered, and a full-thickness composite graft is harvested from the auricle (making the skin component slightly larger than the cartilage component). The auricular defect is covered with a retroauricular island flap (see Fig. 10.1).
- b The defects are closed. The retroauricular surface of the composite graft faces outward.

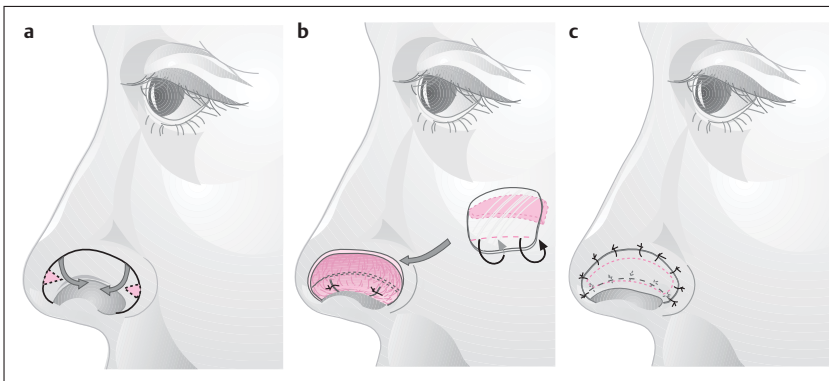


Fig. 5.39 Turnover flap and composite graft (see Fig. 5.37).

- a An incision is made around the alar rim.
- b The flap is hinged over, its edges are freshened, and the turnover flap is sutured in place. A two-layer composite graft is harvested with a slightly larger skin island, and its distal edge is folded over to create an alar rim.
- c The composite graft is inset into the defect.

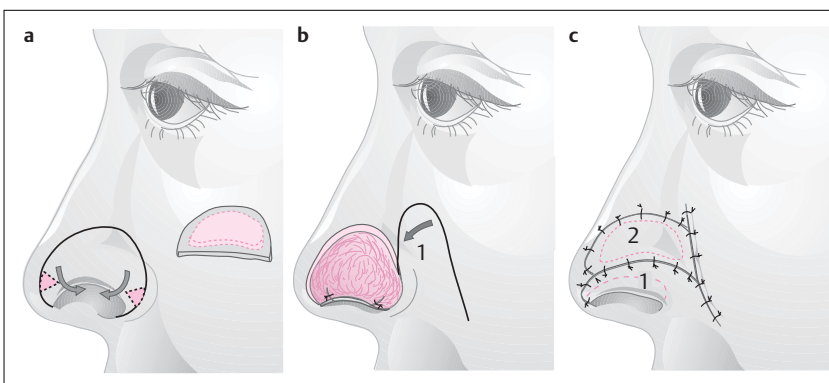


Fig. 5.40 Reconstruction of the alar rim with an inferiorly based transposition flap.

- a Lining is reconstructed with a turnover flap.
- b The ala is reconstructed with an inferiorly based transposition flap (1).
- c The central defect is repaired with a composite graft (2).

graft is infolded to create a natural-appearing rim (Fig. 5.39c).

Converting a Peripheral to a Central Defect (Haas 1991) and Reconstructing the Alar Rim with a Transposition Flap (Fig. 5.40)

In this technique a two-layer or three-layer composite graft is inserted to repair the central defect (Fig. 5.40a).

Wedge-Shaped Defect in the Alar Rim (Fig. 5.41)

Wedge-shaped defects in the alar rim no larger than 1 cm can be covered with a full-thickness composite graft from the auricle (Fig. 5.41). These composite grafts have a success rate of 80%, and livid discoloration during the initial days after graft inset should not cause concern. The skin component should be cut slightly larger than the cartilage, and the fine monofilament sutures should not be spaced too close

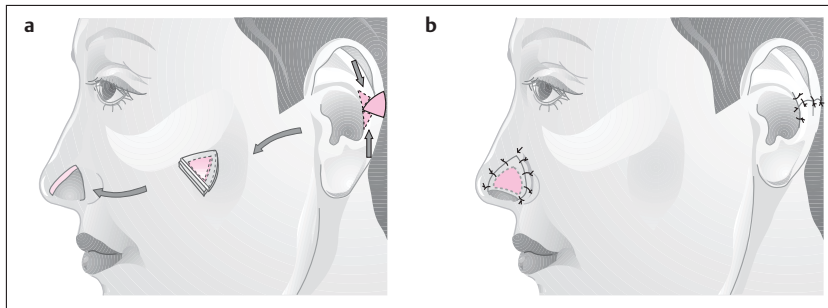


Fig. 5.41 Wedge-shaped alar defect reconstructed with a composite graft.

- a** A full-thickness composite graft is taken from the auricular border, which is closed with the excision of small Burow's triangles, slightly shortening the overall length of the auricle (see also Fig. 28).
- b** Reconstruction of the ala.

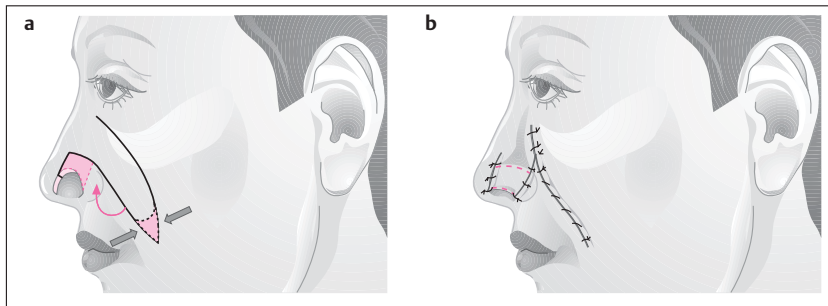


Fig. 5.42 Larger alar defects can be reconstructed with a Nelaton transposition flap from the alar groove.

- a** The flap is cut about 1.5 cm longer than the measured length, as the end is used for lining (that portion is thinned). Flaps for bearded patients are cut above the hair bulbs.
- b** Appearance after closure of all defects (some revision of the flap base may be required).

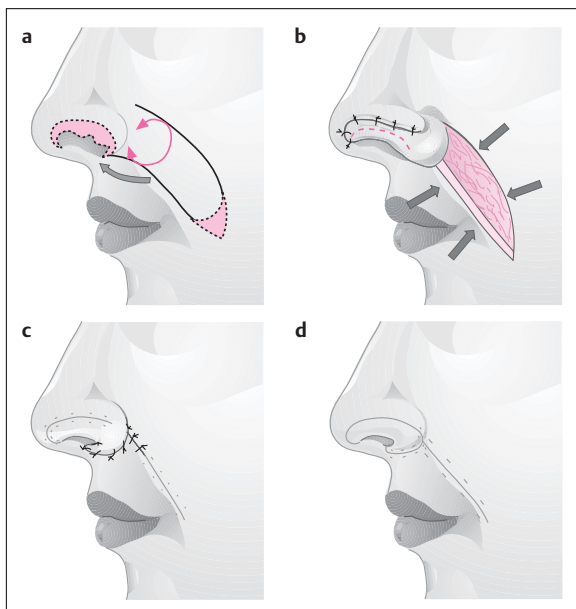


Fig. 5.43 Reconstruction of the alar rim in two stages.

- a, b** Stage 1.
- c** Stage 2: the end of the flap is inset about 3 weeks later.
- d** Result.

together. The reconstructed ala should be immobilized for 8–10 days. Above all, the dressing should not be changed for the first 6 days, as this would jeopardize capillary ingrowth. Harvesting of the composite graft is guided by a pattern matched to the size and shape of the defect. We generally use the aluminum foil wrapper from suture materials to make the pattern.

Nelaton Flap (Nasolabial Flap) (Fig. 5.42)

The Nelaton flap has proved useful for reconstructing larger partial-thickness and full-thickness defects of the ala. The defect should be carefully measured and the flap designed slightly larger and longer. The flap is less satisfactory for bearded patients. The Nelaton flap is a superiorly based flap that is swung into the defect from the nasolabial fold. It can be infolded to reconstruct the alar rim. In men with heavy facial hair, the end of the flap should be thinned; the hair bulbs will be resected. Generally there is no need to add cartilage for structural support. If the entire ala has been resected, the alar groove must be reconstructed in a second sitting. The donor defect in the nasolabial fold is easily closed by mobilizing the surrounding skin (Fig. 5.42b), which gives a barely perceptible scar. The alar rim can also be reconstructed with a nasolabial flap (Fig. 5.43).

Sliding Flap of Barron et al. (1965) and Lejour (1972) from the Nasolabial Fold (Fig. 5.44)

To slide a nasolabial flap to an alar defect with an adequate blood supply, the flap should have a subcutaneous pedicle that is placed laterally above the flap (Fig. 5.44; Barron et al. 1965) or directly below it (Lejour 1972) (Fig. 5.44b). The end of the flap is tapered to create a V-Y type of advancement in the cheek area (see Figs. 3.11–3.13 and Fig. 3.29).

In-and-Out Flap of Peers (1967) (Fig. 5.45)

This flap has an anterior superior subcutaneous pedicle (Fig. 5.45a, b) similar to the sliding flap above. The anterior portion of the flap is used for lining (Fig. 5.45b, c). The lower portion of the nasolabial flap is partially cleared of fat and inset into the alar defect for cover (Fig. 5.45c, d).

Median Forehead Flap (see Fig. 5.15)

Besides providing nasal tip coverage, a median or oblique forehead flap is useful for reconstructing large defects in the nasal ala (Fig. 5.15). The technical details are the same as described on pages 33 and 34.

Bilobed Flap from the Cheek (Weerda 1983) (Fig. 5.46)

In elderly patients with a large excess of cheek skin, an anterosuperiorly based bilobed flap can be taken from the cheek to reconstruct a large alar defect. With older defects, a turnover flap above the nostril can be used for lining (Fig. 5.46a; see also Fig. 5.42a, b), and an alar rim is fashioned by hinging over the lateral part of the first bilobed flap (Fig. 5.46a). The secondary defect is closed by mobilizing the surrounding skin. The cheek just below the eyelid should not be mobilized, and the lower portion of the cheek that has been mobilized upward should be fixed to the periosteum of the orbital rim (Fig. 5.46b). If the secondary defect cannot be closed by primary mobilization of the cheek, it should be closed by means of an Esser cheek rotation like that used with large nasolabial flaps (see Fig. 8.1) or by applying other flap techniques (see Figs. 8.17 and 8.18).

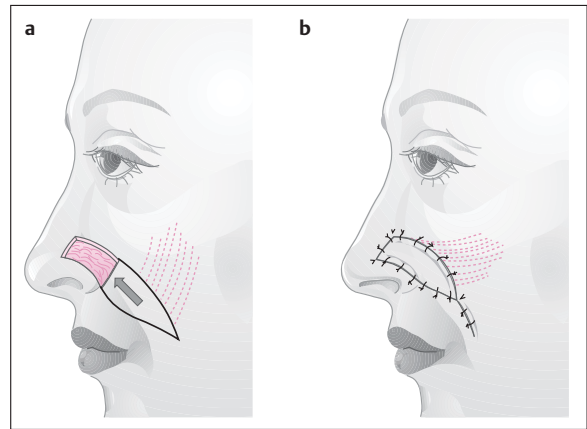


Fig. 5.44 Reconstruction of an alar defect with a **sliding flap** from the nasolabial fold (after Barron et al. 1965; see Fig. 5.33).
a The flap is based superiorly on a subcutaneous pedicle.
b Closure of all defects.

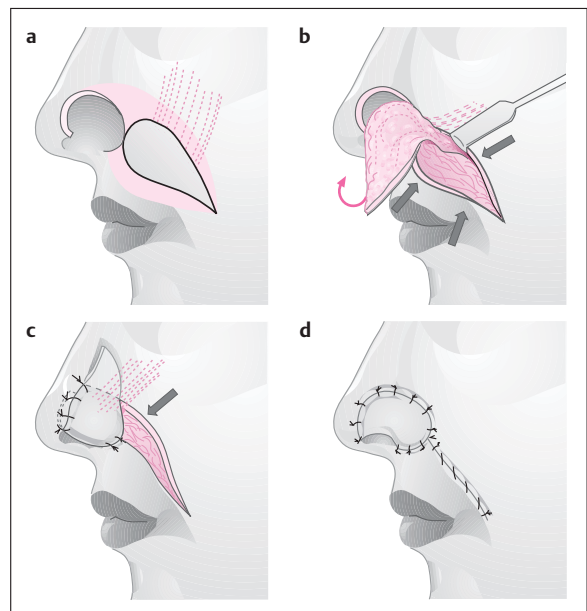


Fig. 5.45 The **"in-and-out flap"** of Peers (1967), used to reconstruct a full-thickness alar defect.

- a A large sliding flap is cut from the nasolabial fold and based on an anterosuperior subcutaneous pedicle. (Do not incise too deeply; dissect on a superficial subcutaneous plane in the cheek.)
- b The upper portion of the flap is used for intranasal lining.
- c The lower portion of the flap is thinned and inset into the external defect.
- d Appearance following the full-thickness reconstruction.

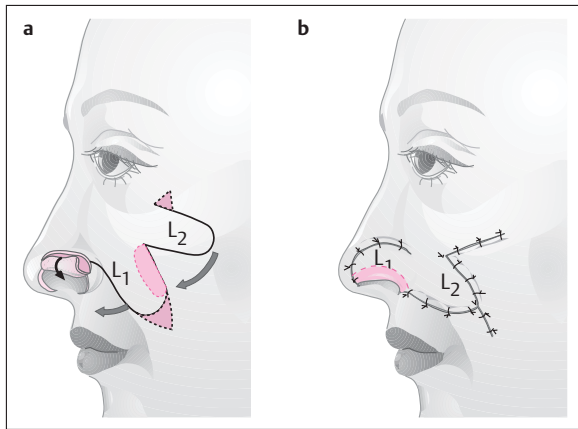


Fig. 5.46 **Bilobed flap from the cheek** (Weerda 1983 c).

- a A turnover flap from the upper nasal defect is used for lining. A small flap is turned over at the lateral edge of the first flap (1). A Burow's triangle is excised as needed (L2).
- b The bilobed flap is rotated into place, and all defects are individually closed.

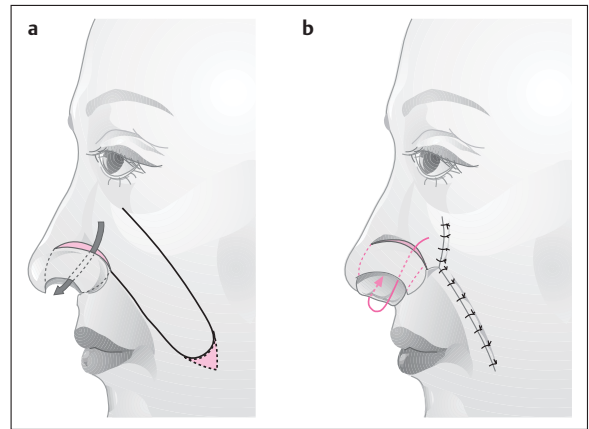


Fig. 5.47 **Nelaton flap** for two-stage reconstruction of the columella.

- a Outline of the Nelaton nasolabial flap.
- b The flap is pulled to the columella through an incision in the alar groove (arrow) and inset. In a second stage, the flap is detached and inset in the cheek area.

The Columella

Nelaton Flap

(Fig. 5.47)

Larger defects of the columella can be reconstructed with a Nelaton flap (nasolabial flap) in patients with scant facial hair (see p. 44). An incision is made through all three tissue layers in the alar groove, conforming to the width of the flap (Fig. 5.47a). The flap is then outlined to match the size of the defect, mobilized, and pulled into the nose through the incision in the alar groove. The necessary flap length should be measured with a paper or cloth strip and an extra 1.5–2 cm of length added. The hair roots can be cut for a length of about 8 mm at the end of the flap. It may be necessary to reinforce the columella with auricular cartilage or with cartilage from the posterior nasal septum (Fig. 5.47b). In a second stage approximately 16–20 days later, the flap is detached within the nose and pulled out of the incision, which is then closed. The end of the flap is inset into the alar groove at the incision site, and occasionally it must be completely detached. In some cases the columellar area may require a later touch-up operation for thinning and scar revision. The nasolabial flap can also be swung around the ala for columellar reconstruction. In this case a piece of silicone film is wrapped around the raw surface of the flap to avoid maceration of the alar rim.

Frontotemporal Flap of Schmid and Meyer (1964)

This flap can occasionally be used for reconstructing the columella, especially when a concomitant nasal tip reconstruction is required (see Fig. 5.18).

Composite Graft

(Fig. 5.48)

Smaller defects of the columella can be reconstructed with a composite graft from the helix (see Auricular Surgery, Fig. 10.4).

Partial and Total Nasal Reconstruction

Median or oblique forehead flaps (see Figs. 5.15, 5.16, 5.49, and 5.53) can be effectively used for nasal reconstruction, depending on the size and location of the defect. In other cases turnover flaps can be used in conjunction with nasolabial flaps (see Figs. 5.11 and 5.40) or bilobed flaps (see Fig. 5.46), or complex flaps may be required. Various flap combinations can be used in the reconstruction of large defects.

When a large forehead flap has been transferred (see Figs. 5.16 and 5.49), the upper two-thirds of the donor defect can be closed by an H-advancement of the forehead skin (Fig. 5.49c) or with bilateral rotation flaps (Fig. 5.49d). If the scalp is hair-covered, the superior flap incisions should be placed about 2 cm behind the hairline. The flaps should be securely

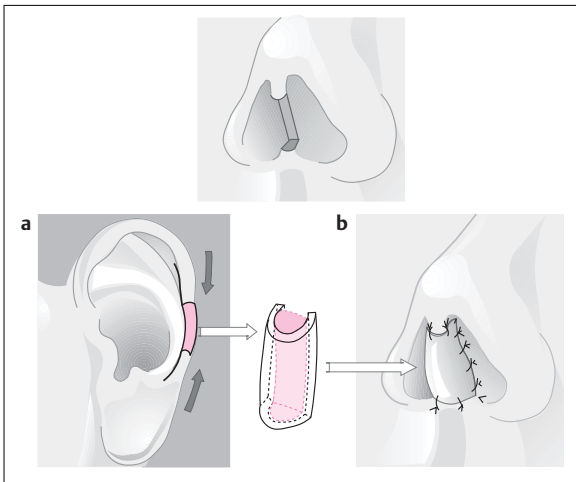


Fig. 5.48 **Columellar reconstruction** with a full-thickness composite graft from the helix.

a Donor site.

b Inset of the composite graft (see Gersuny's technique for resecting a helix tumor, Fig. 10.5).

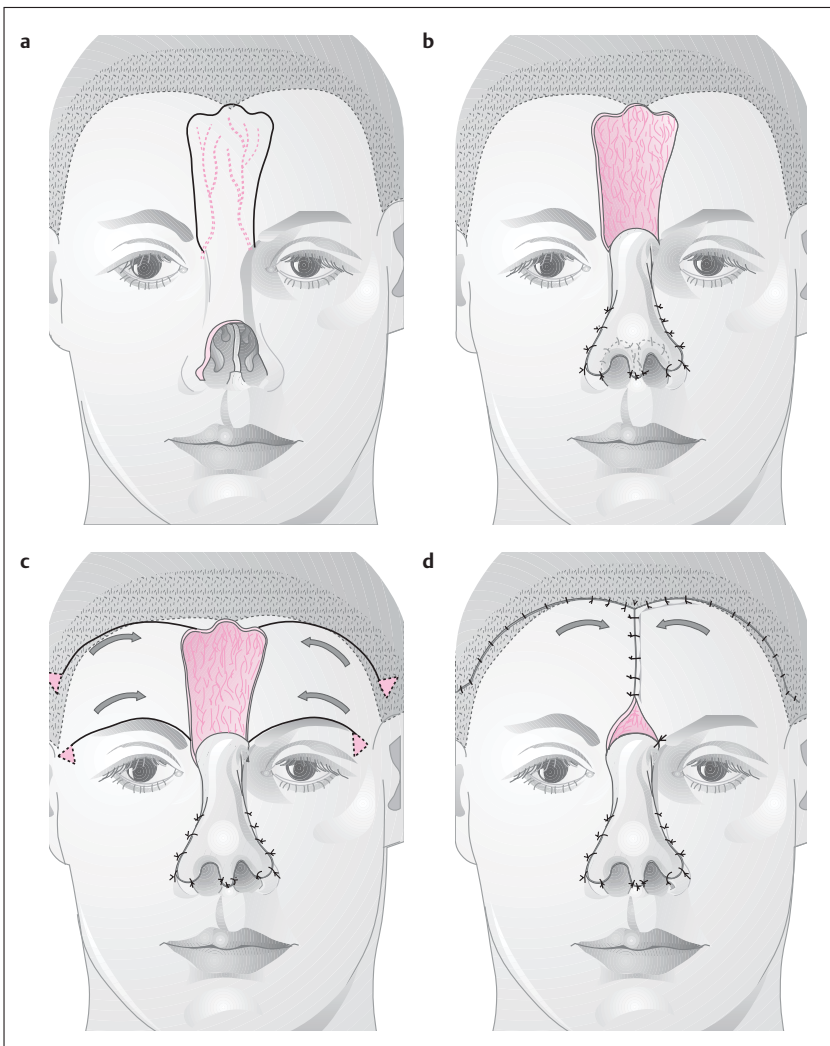


Fig. 5.49 Nasal reconstruction using a large **median forehead flap** (see Figs. 5.15 and 5.16).

a The forehead flap is outlined. The nasal lining can be reconstructed with split-thickness skin, a nasolabial flap (see Fig. 5.42), or a sliding flap (see Fig. 5.44).

b Inset of the flap into the defect.

c, d The donor defect can be closed with an H-flap (**c**) or bilateral rotation flaps (**d**) (see Figs. 4.2–4.4).

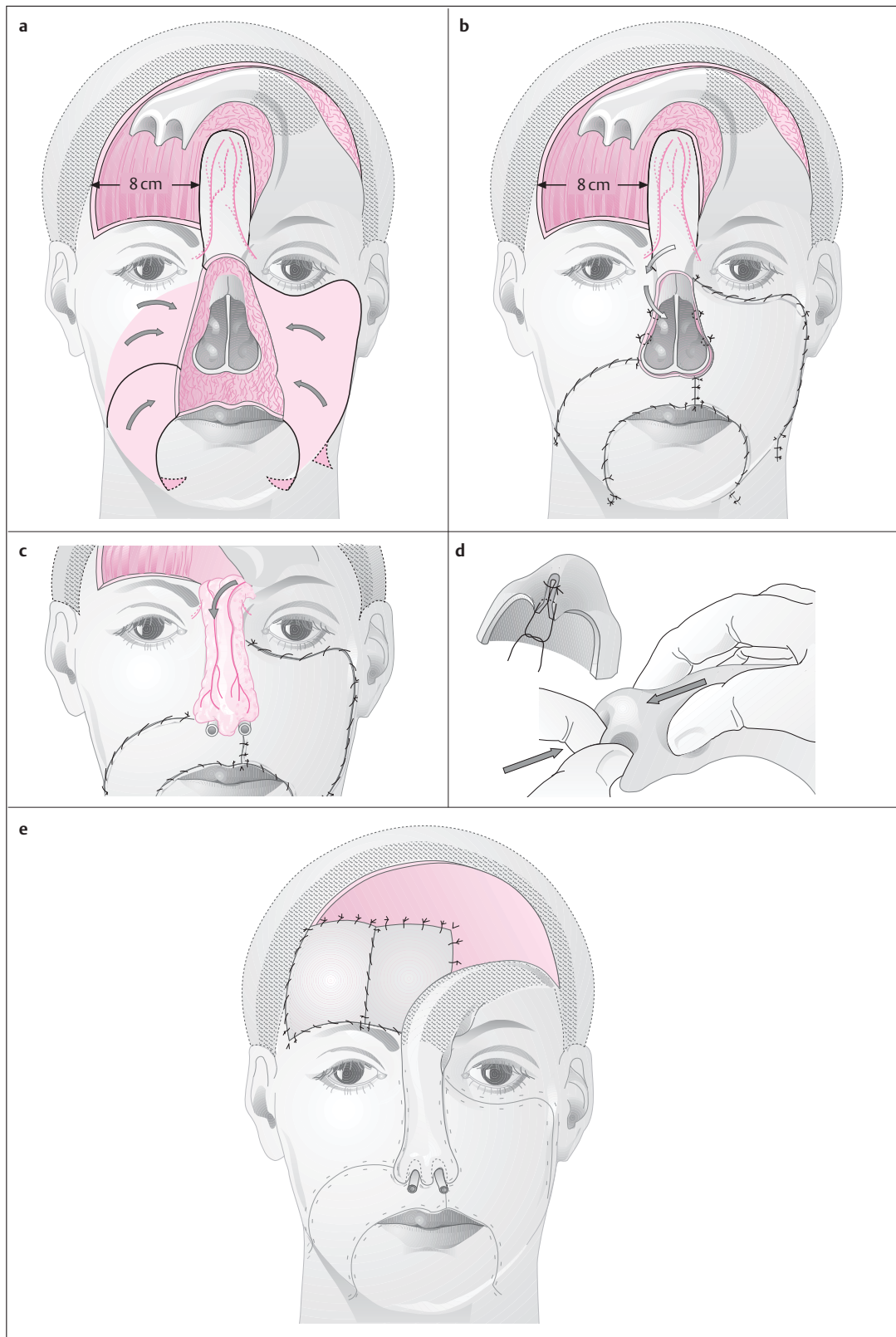


Fig. 5.50 Reconstruction of the **nose, cheek, and upper lip**.
a, b The esthetic unit of the cheek and upper lip is reconstructed with an Esser cheek rotation (left), cheek advancement (right), and modified Grimm lip reconstruction (see Fig. 6.45).

c Nasal lining is reconstructed with a median forehead flap placed over silicone stents.
d, e The external nose is reconstructed with a Converse scalping flap (see Fig. 5.51).

coapted with absorbable subcutaneous sutures. Further details on these flaps are shown in Figure 5.15. Oblique forehead flaps can also be used (see Figs. 5.16 and 6.4).

Converse Scalping Flap (Forehead-Scalp Flap)

(Figs. 5.50 and 5.51)

Use of the converse scalping flap is illustrated for subtotal or total nasal reconstruction with partial reconstruction of the upper lip and cheek (Fig. 5.50). The neighboring esthetic units should be reconstructed prior to the nasal reconstruction (Fig. 5.50a, b). Soft-tissue expansion in the forehead (see Figs. 4.5 and 5.16) may precede the reconstruction.

Stage I: If necessary, a median forehead flap is used for nasal lining (Fig. 5.50a, b; see also Fig. 5.15). This flap is turned inferiorly (Fig. 5.50c) and sutured to the residual nasal mucosa. Silicone stents or acrylic struts are inserted at this stage for structural support. The incision for the forehead-scalp flap starts above the eyebrow to the right or left of the median forehead flap and is continued upward. For a total nasal reconstruction, this flap should be at least 8 cm wide and should span the full height of the forehead. Care is taken to preserve the frontal muscle as the flap is dissected upward. The scalping portion of the incision curves behind the hairline and ends behind the auricle on the opposite side. This large flap is supplied by numerous branches of the superficial temporal artery along with the contralateral supraorbital vessels (Fig. 5.51a, b; see also Fig. 2.8c).

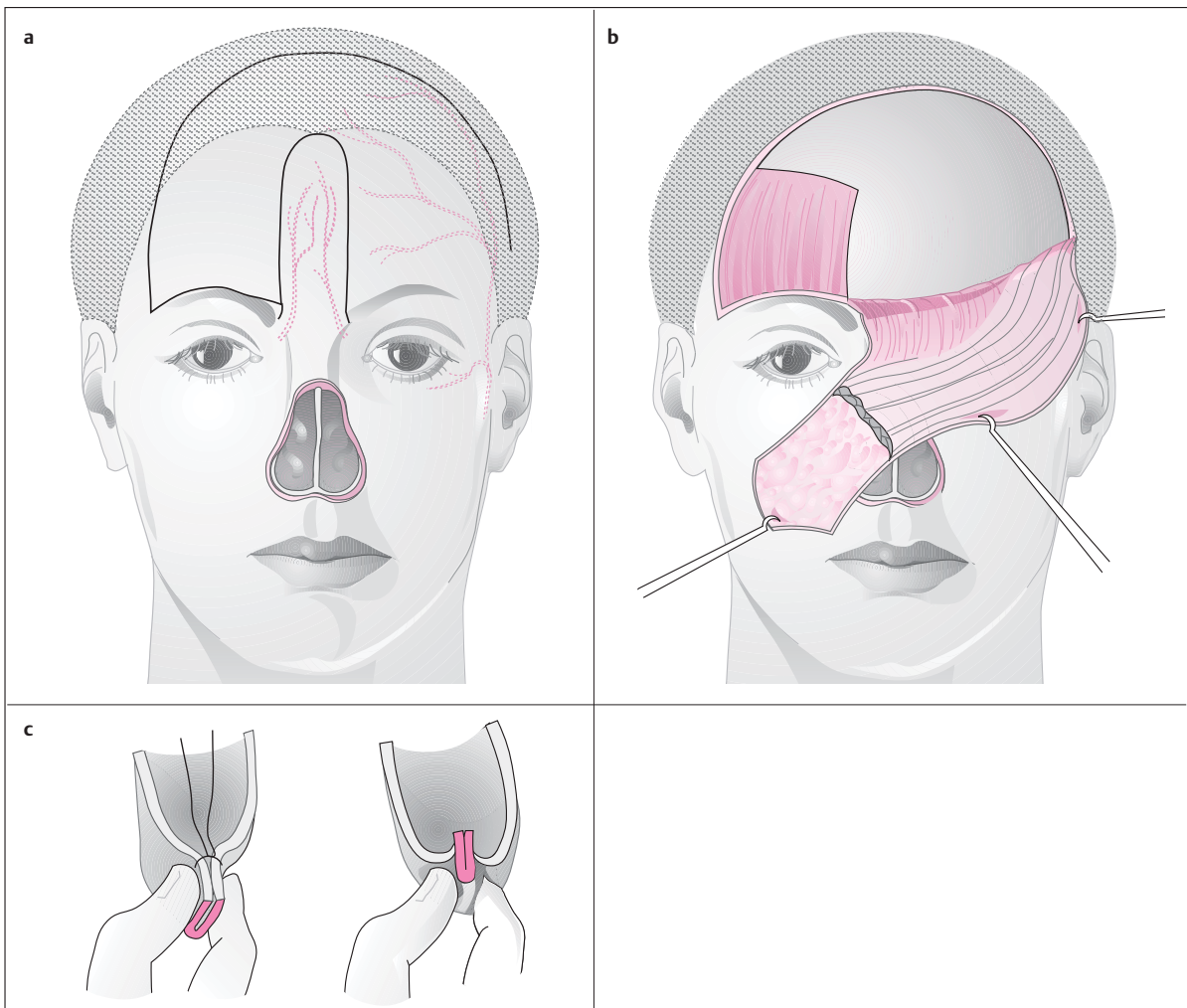


Fig. 5.51 Reconstruction of the external nose with a Converse scalping flap (see Fig. 5.50). The outline of the laterally based forehead flap is shown (minimum width 8 cm, spans full height of forehead).

a The scalp flap is incised to the galea, and meticulous hemostasis is obtained.

b Elevation of the forehead and scalp flap (see Fig. 5.50a).

c The distal portion of the forehead flap is folded and sutured to create a new nose.

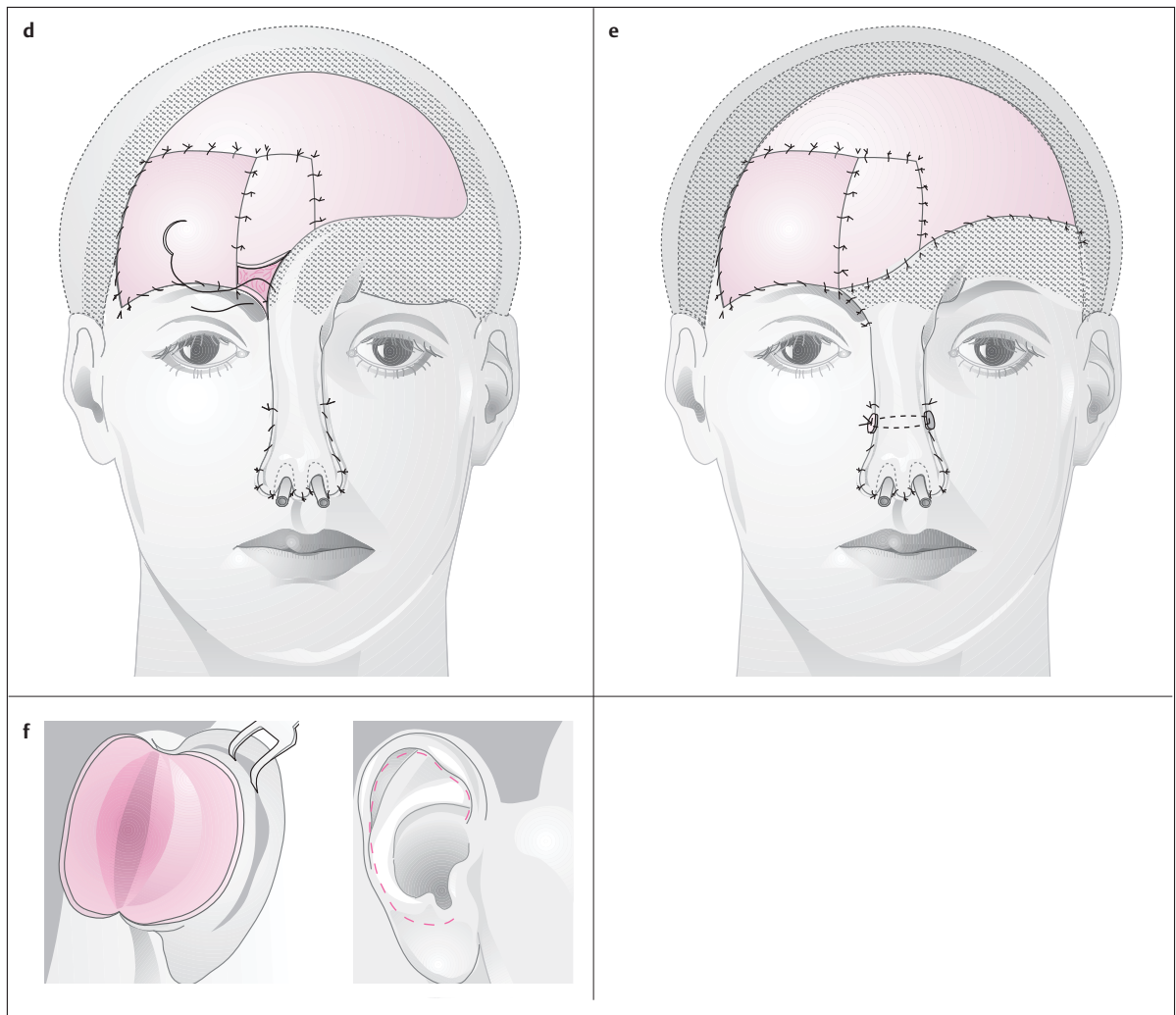


Fig. 5.51

d The new nose is inset over silicone stents with an outer diameter of approximately 8 mm.

e, f After the granulation tissue in the residual defect has been conditioned (see text), the defect is grafted with retro-

auricular and postauricular full-thickness skin (good color and texture match). The auricular defect is grafted with split-thickness skin from the buttock or groin.

Following careful hemostasis, the entire scalp flap is brought downward with the well-perfused, relatively thin forehead flap. The forehead flap is folded to the desired shape (Figs. 5.50d and 5.51c) and inset into the nasal defect (Figs. 5.50e and 5.51d, e). The galea and pericranium are preserved and are covered with impregnated gauze or film (Fig. 5.51d). We allow the forehead defect to fill with granulation tissue. The soft granulations are repeatedly removed until a firm, stable granulating bed has reached the level of the surrounding forehead skin. Then the defect is grafted with full-thickness skin from the retroauricular and postauricular region on one or both sides or with skin from the supraclavicular region (Figs. 5.50e and 5.51e, f). As a guide, we use a paper or foil pattern tailored to the size of the defect.

A full-thickness skin graft from the supraclavicular region can be used for nasal lining as an alternative to the median forehead flap. However, the somewhat thicker midline forehead flap provides a better framework for the cartilage strut that will be inserted later for structural support. We prefer to add supporting materials at a later time rather than insert cartilage grafts during the first operation. If the forehead region has been expanded, large portions of the forehead defect can be closed in the initial sitting.

Stage II: About 3 weeks later the scalp flap can be incised and eventually detached from the reconstructed nose. The granulations on the scalp are removed, the edges of the flap freshened, and the unused portion of the flap is returned. At this time (no later!) the forehead defect is again freed of soft

granulations and grafted with full-thickness skin (see Figs. 5.50e and 5.51e). Any necessary corrections such as defatting, scar revisions, etc. are performed about 6 months later. Further minor corrections can be added in later touch-up operations.

Total Nasal Reconstruction with the Sickle Flap (Farrior 1974)

(Fig. 5.52)

As in other reconstructions following total nasal loss, the forehead skin can be augmented by soft-tissue expansion for 6–8 weeks before the flap is incised (see Fig. 4.5).

Stage I: The skin flap is taken from the median forehead, and its distal end is preshaped to form the alae and columella. As with the Converse scalping flap (Figs. 5.50 and 5.51), the flap should not be made too narrow (Fig. 5.52a). It receives its blood supply from branches of the superficial temporal artery. Nasal lining is reconstructed with a thick split-thickness or full-thickness skin graft from the supraclavicular region. We stent the nostril openings with 8-mm silicone tubing (Fig. 5.52b). Incisions can be made over the eyebrow and in the scalp in an attempt to reduce the size of the donor defect in the forehead or close it primarily (see Figs. 4.2, 4.3, and 5.49). As with the

Converse flap, the pericranium is left intact and is covered with impregnated gauze or a similar dressing during healing of the reconstructed nose.

Stage II: About 3–4 weeks after inset of the new nose, the pedicle is first partially incised on both sides and then divided, and the sickle flap is returned to the scalp.

- Residual defects in the forehead are grafted in the same sitting with retroauricular or postauricular full-thickness skin (see Fig. 5.51d, e). Again, the granulation tissue should reach the level of the surrounding skin.
- If necessary, costal or auricular cartilage can be implanted at this stage for intranasal support.

Stage III: Approximately 6 months later, the flap is defatted and secondary scar revisions are carried out.

Median Forehead Flap with Soft-Tissue Expansion

(Fig. 5.53)

In this technique the median forehead skin is expanded with a 200-mL envelope for 6–8 weeks, and then a forehead flap is incised to match the nasal defect (Fig. 5.53; Siegert et al. 1992, 1994; see also Fig. 5.49 and Fig. 5.16, oblique forehead flap).

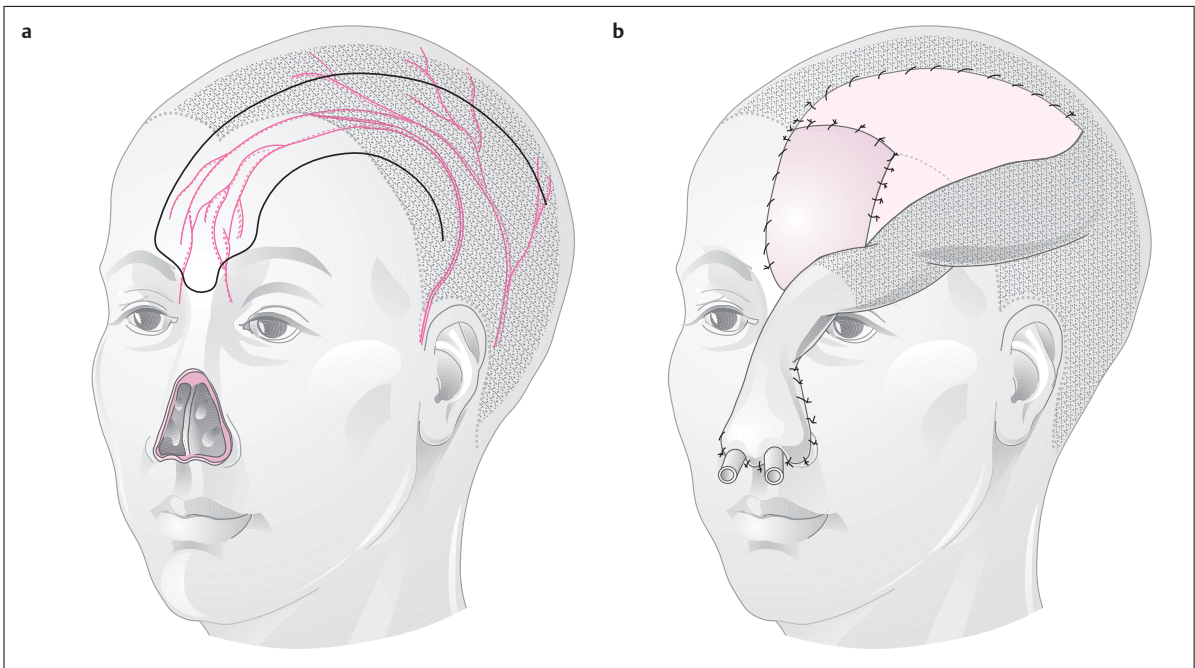


Fig. 5.52 Sickle flap of Farrior (1974).

a The lower portion of the sickle flap is a median forehead flap at least 8 cm wide. It is supplied by a “transport flap” incised in the scalp and based on the superficial temporal artery (the galea remains intact).

b The forehead flap is inset into the defect over silicone stents (lining see text). Closure of the donor defects is the same as with the Converse scalping flap (Figs. 5.50 and 5.51 e, f).

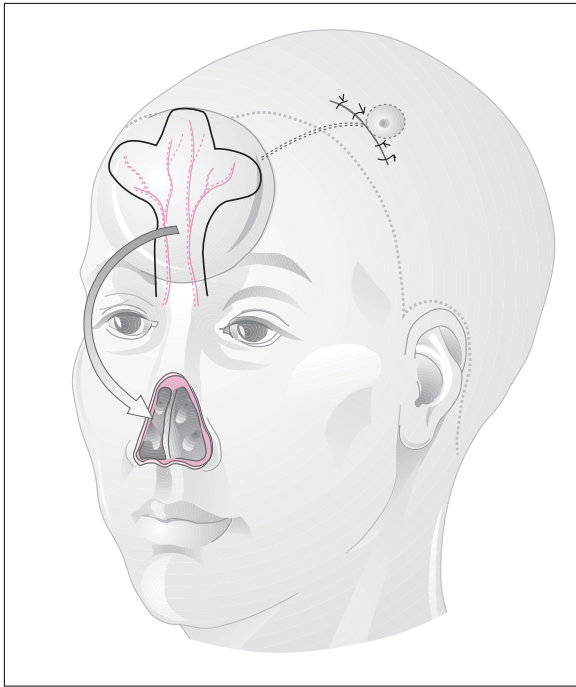


Fig. 5.53 **Broad median forehead flap** following preliminary soft-tissue expansion with a 200-mL expander. A small incision in the scalp gives access for inflating the envelope. The flap is dissected from the galea and periosteum in a subcutaneous plane, preserving the frontalis muscle (oblique forehead flap, see Fig 5.16). Better results without a rigid scar we can get with lateral expansion (see Fig. 4.5).

Nasal Reconstruction with Distant Flaps

Today it is unusual for surgeons to use distant flap techniques such as the upper arm flap (Tagliacozzi) or “jumping” a flap to the face via the wrist or upper arm. Free flaps such as the radial forearm flap (see Fig. 14.1) may give a poor color and texture match for nasal reconstructions and are used only in exceptional cases where donor sites close to the defect are unavailable.

Perforations of the Septum

Small Perforations

Small septal perforations can be managed with small unilateral or bilateral U-advancement flaps, which can be elevated in one or two layers (Fig. 5.54). Small unilateral or bilateral rotation flaps (Fig. 5.55) and bipediced flaps (Fig. 5.56) may also be considered. We have also used anteriorly or posteriorly based mucosal flaps from the inferior nasal turbinate, in which case a small piece of turbinate bone may be transferred with the flap (Fig. 5.57a). A second operation is needed for dividing the flap and inseting it into the anterior or posterior wound margin in the septum.

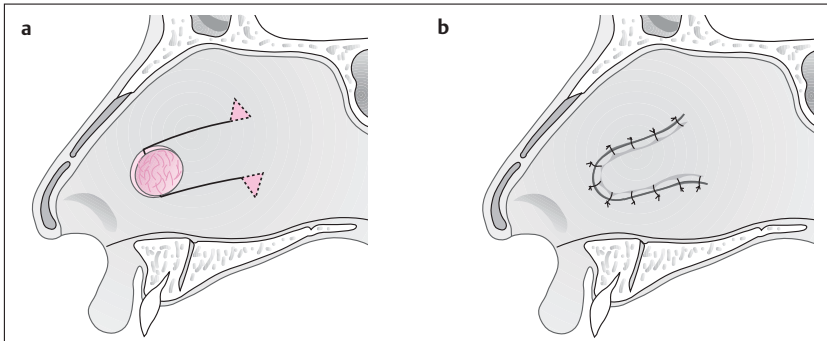


Fig. 5.54a,b **U-advancement flap**

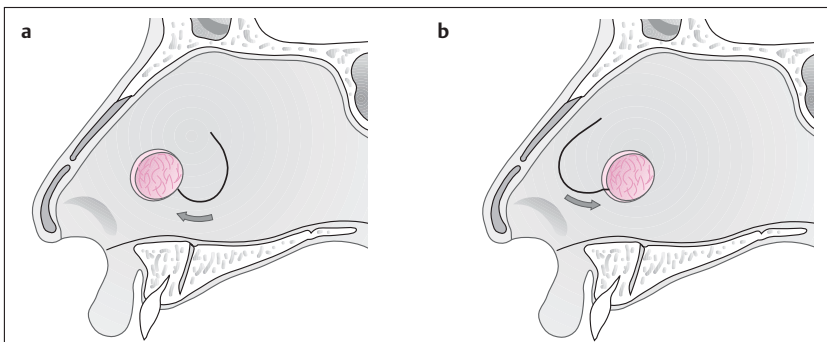


Fig. 5.55a,b **A rotation flap** may be incised anterior or posterior to the defect.

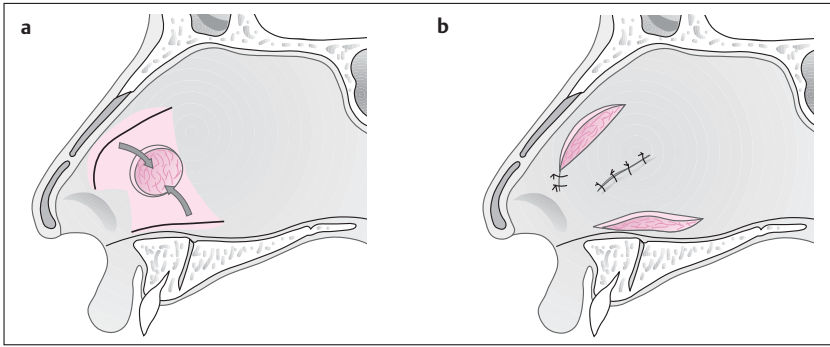


Fig. 5.56 a, b Bipedicled flap

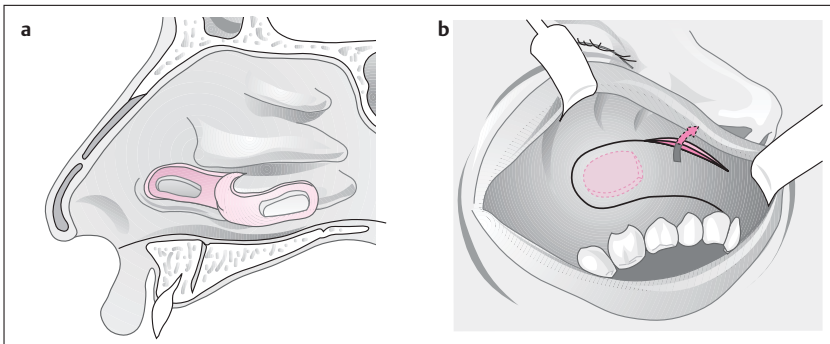


Fig. 5.57 a Posteriorly (or anteriorly) based flap from the inferior turbinate (may include a piece of bone).

b Meyer's intraoral mucosal flap. The flap is precut and prelined with a cartilage graft. Two weeks later it is delivered through a tunnel to the nasal septum. The wound is closed in two layers, and the flap is detached at 3 weeks.

Large Defects

Oral Mucosal Flap of Meyer (1988) (Fig. 5.57b)

Meyer described a technique in which a medially or laterally based mucosal flap is first dissected from the oral vestibule and lined with mucosa or a composite graft matching the size of the defect. In a second stage, the flap is brought upward to the defect through a tunnel in the vestibule and septal mucosa, where it is sutured into place. If necessary, the entire anterior nose can be opened up for this operation. The pedicle is later divided.

Nasolabial Flap of Tipton (1975) (Fig. 5.58)

Tipton suggested using the Nelaton flap for larger defects in 1975. The ala is detached for its full thickness, and the Nelaton flap is sutured into the defect (Fig. 5.58a). The upper edge of the flap can be deepithelialized prior to inset. The second side can be left to granulate. Three weeks later the flap is detached and the ala returned to its original position (see Fig. 5.47).

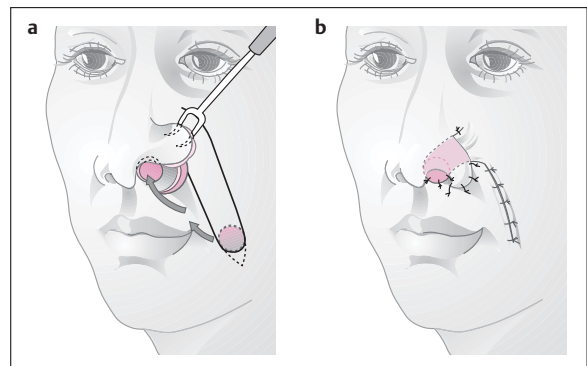


Fig. 5.58 Nasolabial flap

a The ala is detached, and the Nelaton flap is raised.
b The Nelaton flap is swung into the septal defect and inset, and the ala is returned to its original position and sutured into place. (In a second stage the flap is detached and the alar groove is closed.)

Bipedicled Flap of Schultz-Coulon (1989) (Fig. 5.59)

First the mucosa on both sides of the septal defect is undermined from the front through a transfixion incision, and the defect is freshened. The entire mucosa

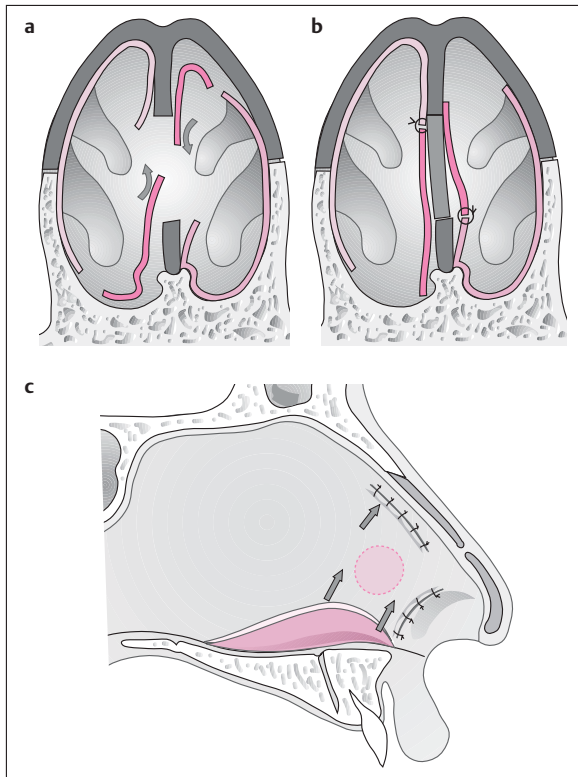


Fig. 5.59 **Bilateral bipediced flap** technique of Schultz-Coulon (1989).

- a** The septal mucosa around the defect is mobilized through a hemitransfixion incision, and the entire mucosa is mobilized past the nasal floor to the inferior turbinate (here on the right side). The mucosa on the left side is separated past the nasal dorsum. The mucosa on the right side is incised below the turbinate and mobilized, and the mucosa on the left side is incised dorsally and mobilized. (These flaps can also be incised superiorly or inferiorly on both sides.)
- b** Bilateral coverage of the septal defect.
- c** Closure viewed from the right side.

on one side is then mobilized down to the nasal floor and inferior turbinate, divided (Fig. 5.59a, right), and advanced toward the defect (Fig. 5.59b, right). On the opposite side, the mucosa above the defect is mobilized past the sidewall and dorsum and divided (Fig. 5.59a, left). The mucosal flap is then pulled down over the defect like a roller shade, and the defects are closed (Fig. 5.59c). This can also be done with mucosa that is mobilized only superiorly or only inferiorly.

6 The Lips

All operations on the lips should restore both the esthetic appearance of the lips and their function, i.e., their ability to maintain oral continence during eating and drinking. Our suture material of choice for approximating muscle stumps about the lips is 4-0 or 5-0 absorbable, and we prefer 6-0 or 7-0 monofilament for the mucosa.

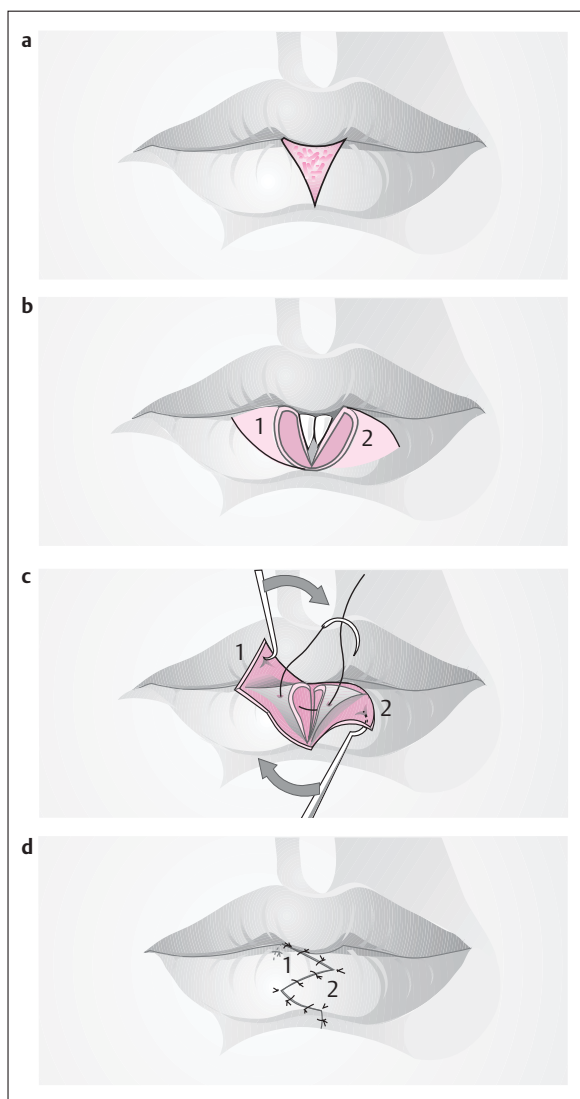


Fig. 6.1 **Wedge-shaped defect** in the vermilion of the lower lip.

- a The defect is excised.
- b Inferiorly and superiorly based mucosal triangles are cut in preparation for a Z-plasty.
- c The triangles are transposed, and the muscular wound is closed.
- d The small skin defects are closed.

Mucosal Defects

Wedge-Shaped Defects

(Fig. 6.1)

Small scars or defects can be excised (Fig. 6.1a) and closed using a Z-plasty technique (Fig. 6.1b-d; Defourmentel et al. after Converse 1977).

Large Superficial Defects

(Fig. 6.2)

Vermilion defects involving up to one-third the length of the lip can be repaired with a sliding flap (Fig. 6.2a), or the entire myomucosal stump can be mobilized as an advancement flap as described by Goldstein (1990). The natural elasticity of the lip mucosa permits good coverage of the defect (Fig. 6.2b; see also Fig. 6.53). These techniques can also be combined with the methods described by Blasius (see Figs. 6.25 and 6.26).

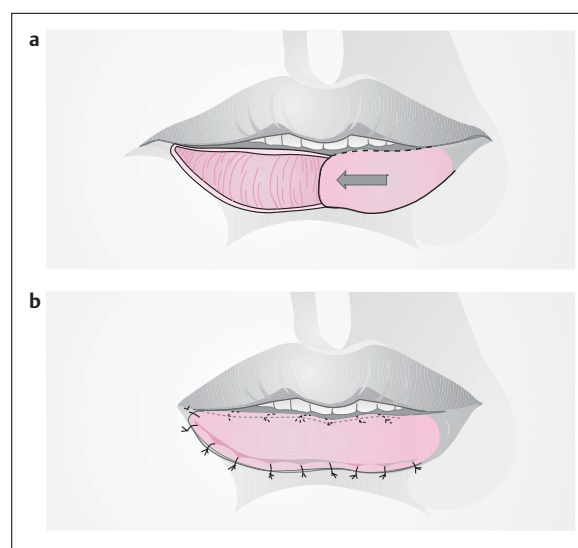


Fig. 6.2 **Large superficial mucosal defect in the right lower lip** (involving less than one-third of the lip).

- a The intact lip mucosa is mobilized and advanced to cover the defect.
- b The flap is sutured in place (see Fig. 6.54).

Upper Lip

Median Deficiency

(Fig. 6.3)

A small median notch or deficiency in the cupid's bow of the upper lip can be corrected by advancing the adjacent vermillion toward the midline using the V-Y method (Fig. 6.3a, b).

Thin Upper Lip

(Figs. 6.4–6.6)

Unilateral thinness of the upper lip (or lower lip) can be corrected by measuring the deficit (Fig. 6.4a), excising a strip of skin, and advancing the mobilized vermillion (Fig. 6.4b). If median defi-

ciency is present, a V-Y advancement from the lateral vestibule (Fig. 6.5a, b) can add fullness to the lip. This incision is carried farther laterally than in Figure 6.3. We also can use a w-plasty (Fig. 6.6)

Thin Upper Lip and Full Lower Lip

(Fig. 6.7)

A bipedicle flap can be used to add substance to the upper lip in a patient with a full lower lip, and vice-versa (Fig. 6.7a, b). The pedicle is divided about 3 weeks after the initial transfer.

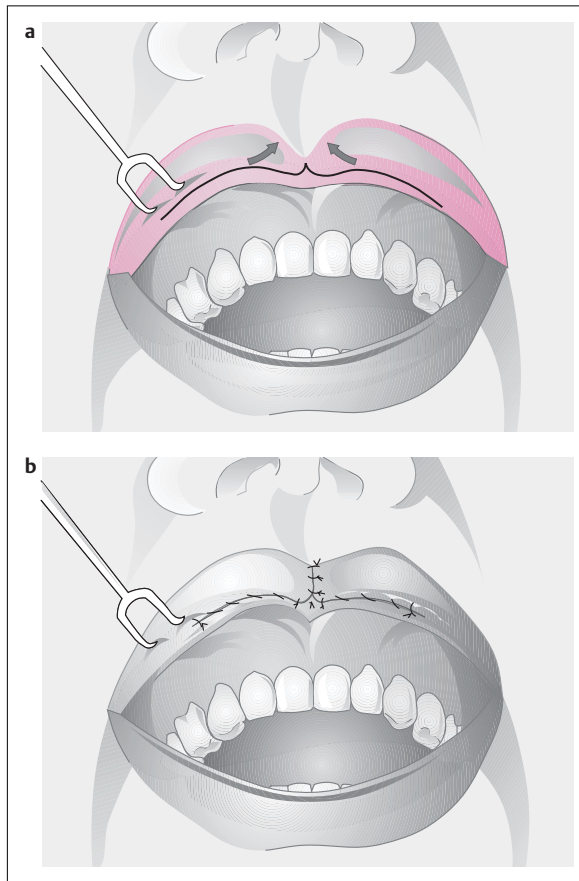


Fig. 6.3 **V-Y advancement** for adding median fullness to a thin upper lip.

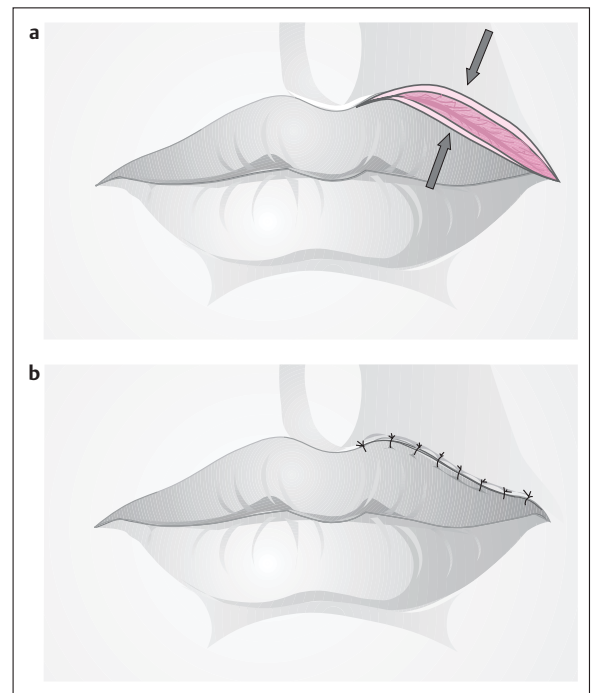


Fig. 6.4 **Widening the upper lip on one side.**

- a The lip height is measured on the opposite side and drawn on the affected side. A strip of skin is excised, and the vermillion is slightly mobilized.
- b The incision is closed (with 6-0 or 7-0 monofilament) to create a new vermillion border. This type of operation can be used for total advancement of the upper lip area.

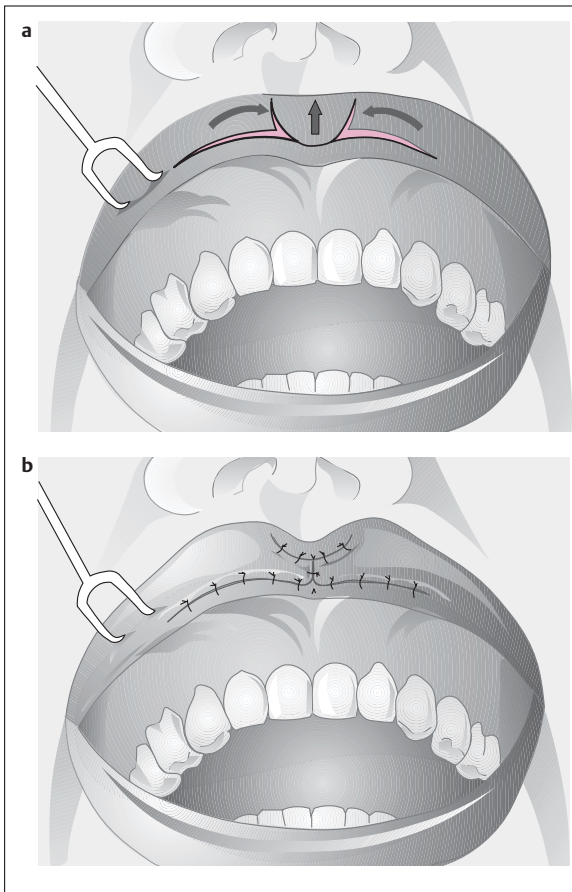


Fig. 6.5 **V-Y advancement for adding upper lip fullness** and improving the shape of the cupid's bow.

- a** The flap incisions are made, skirting the cupid's bow.
b The V-Y advancement is completed.

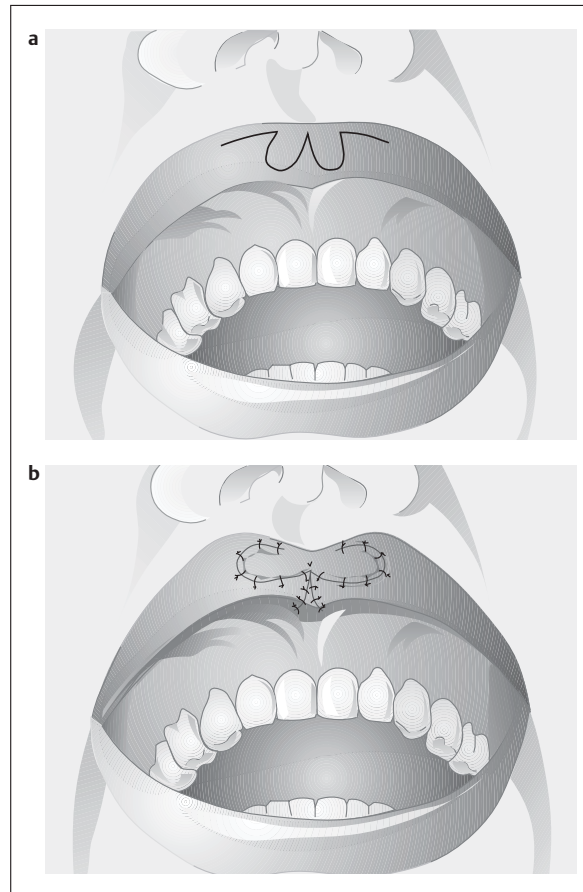


Fig. 6.6 **W-plasty for adding substance** to the mid-upper lip.

- a** The W-shaped incision is made around the vestibular mucosa and is carried laterally into the upper lip.
b The small flaps are transposed to close the defects.

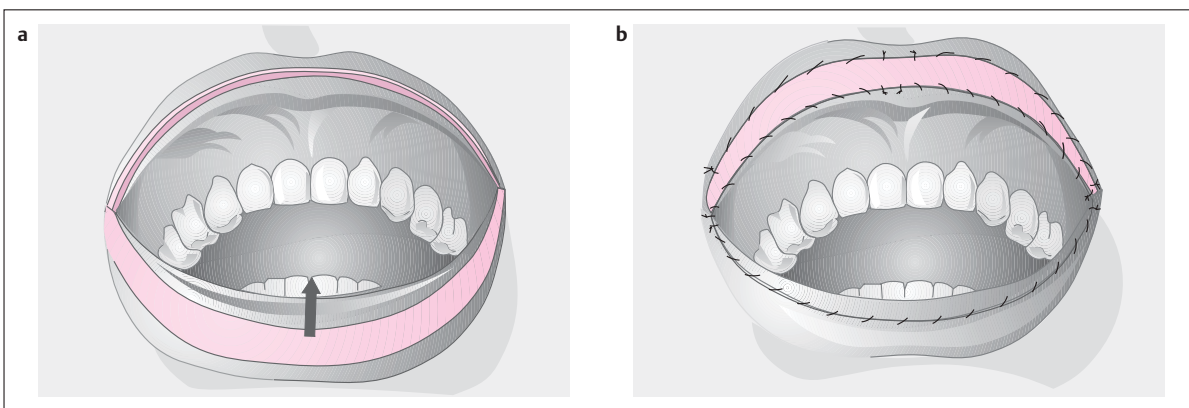


Fig. 6.7 **Augmenting the upper lip** from a full lower lip.

- a** A bipedicle flap is cut from the lower lip, and the upper lip is incised.
b The bipedicle flap (mucosa or myomucosa) is transferred to the upper lip. The donor defect is closed (the flap base is divided and inset 3 weeks later).

Median Scars and Upper Lip Defects

In cases where the central portion of the upper lip is retracted upward due to scarring after a cleft repair, burn, or the irradiation of a hemangioma, the lip can be reconstructed using a method first described by Celsus (ca. 25 A.D.). A two-layer, crescent-shaped excision is made lateral to the alar groove on each side and extended along the nasal base. A portion of the scar can be excised (Fig. 6.8a). Both upper lip stumps are then rotated and carefully sutured together to bring down the retracted vermilion (Fig. 6.8b). The

muscle stumps are carefully approximated with 4–0 or 5–0 absorbable suture material.

After the vermilion scar has been divided and excised, a Z-plasty can be incorporated to add fullness to the upper lip and lower the vermilion (Fig. 6.9). With greater upward retraction of the upper lip, the incision along the nasal base and alar groove can be extended at an approximate right angle along the nasolabial fold. The flaps are then rotated toward the midline to restore a natural-appearing upper lip (Fig. 6.10). The lip muscles are reapproximated separately in this type of operation.

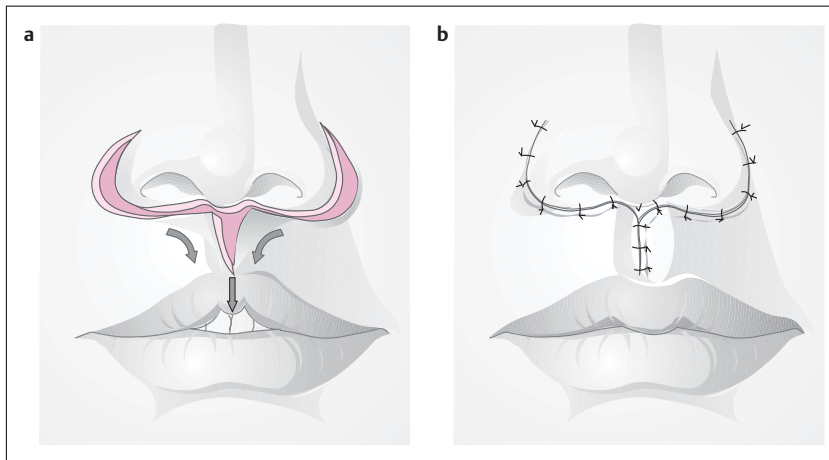


Fig. 6.8 **Correction of upper lip contracture** following a cleft repair.

- a** Crescent-shaped excisions are made lateral to the alar groove, and the scar is excised. The lip is mobilized and brought down to a normal position.
- b** All defects are closed.

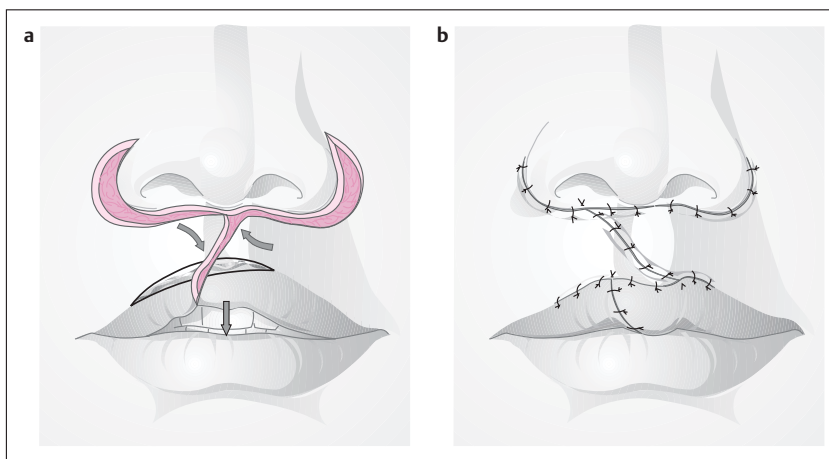


Fig. 6.9 A Z-plasty can be added to **adjust the position of the vermilion** (see Fig. 6.8).

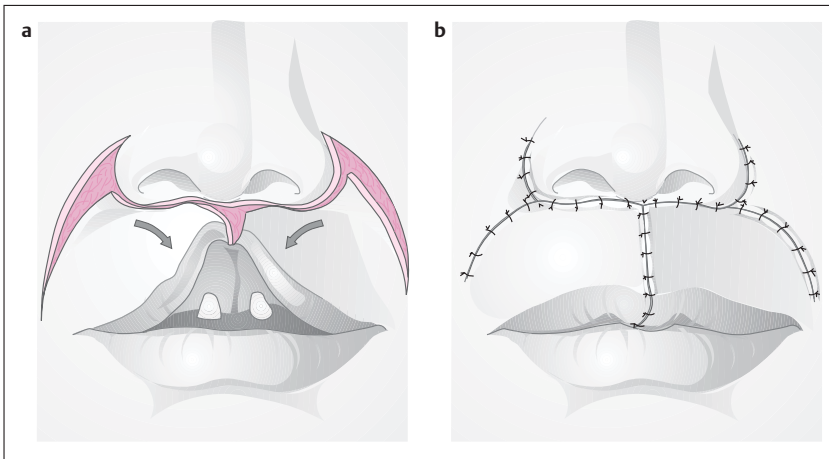


Fig. 6.10 **Distortion of the vermillion** due to scar contracture.

- a** The scar is excised, and releasing incisions are made in the nasolabial folds.
- b** The vermillion is brought downward, and the defects are closed (see also Fig. 6.28).

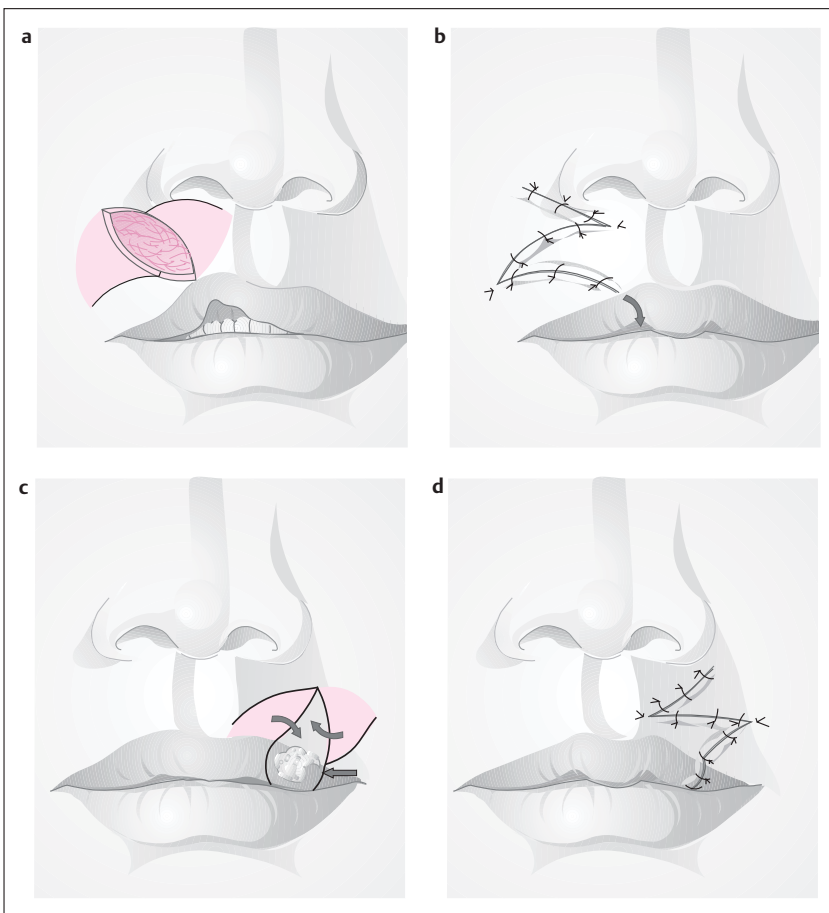


Fig. 6.11 **Tumor or scar** in the upper lip.

- a, c** The tumor is excised, and the Z-plasty incision is made.
- b, d** The scar is dispersed. The lip defect is closed.

Scar Revisions

Small Contractures (Fig. 6.11)

In cases where the upper lip has been retracted upward on one side by a small scar, the scar is excised and then dispersed with a Z-plasty. This adds length in

the direction of the scar and restores a normal shape to the upper lip. A similar technique is used after the excision of small tumors (Fig. 6.11c, d; Härtle 1993).

Larger Contractures (Fig. 6.12)

Burns, caustic injuries, and scar contractures can cause severe distortion of the upper lip. The revision technique is as follows:

1. The scar is excised down to muscle, and the vermillion is mobilized (Fig. 6.12a, b).
2. A pattern is made out of paper, cloth, or aluminum foil (Fig. 6.12b).
3. The pattern is used to harvest a full-thickness retroauricular skin graft (Fig. 6.12c).
4. The full-thickness skin graft is inset using fibrin glue and 6-0 or 7-0 sutures. Alternating sutures are left long (Fig. 6.12c, d).
5. The long sutures are tied over a foam bolster or Vaseline gauze dressing for 6-7 days (Fig. 6.12e).

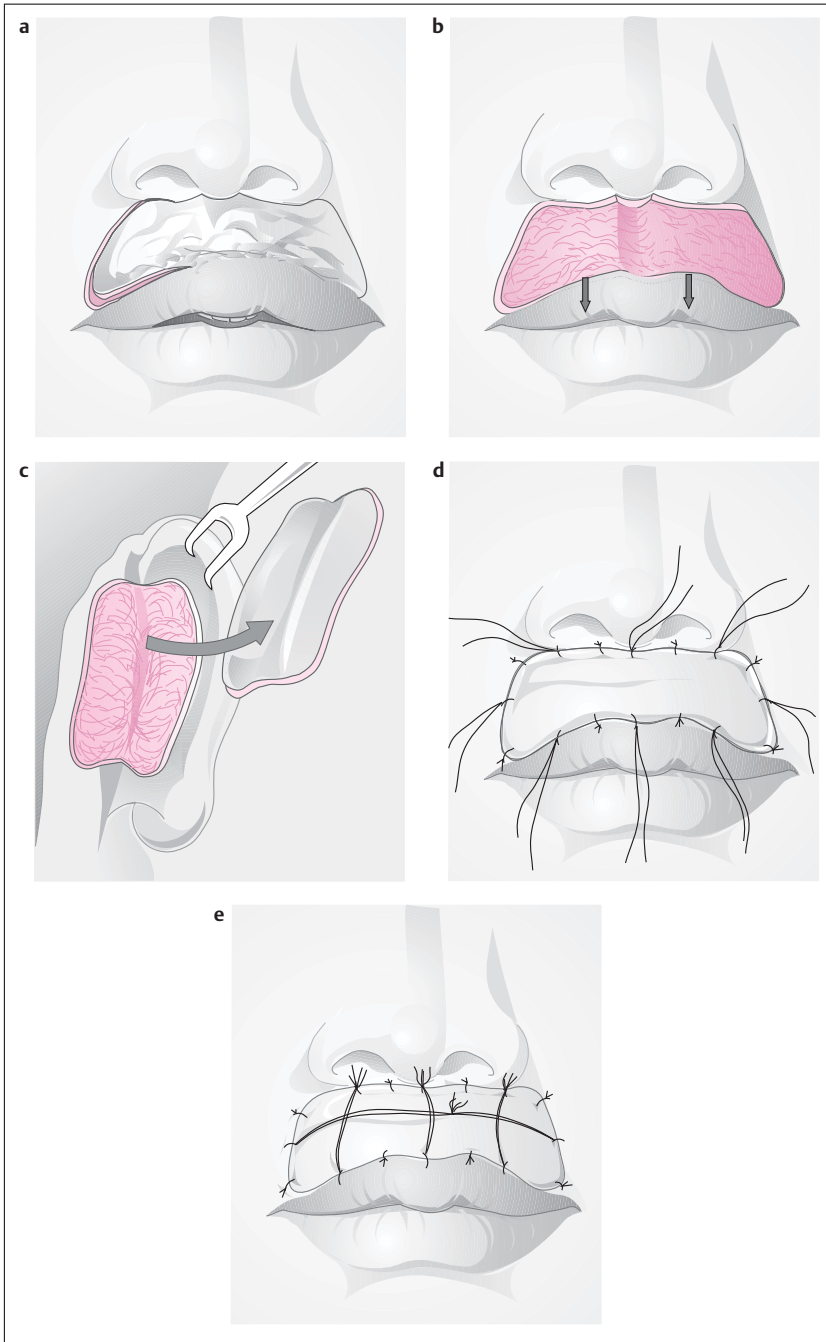


Fig. 6.12 **Large burn scar** of the upper lip covered with a full-thickness skin graft.

- a Distortion of the upper lip following burn scar contracture.
- b The scar is carefully excised, and the vermilion is mobilized. A pattern is made.
- c A full-thickness retroauricular skin graft is harvested using a pattern made of paper or aluminum foil (suture wrapper).
- d The full-thickness skin graft is sutured into the defect with 5-0 monofilament. Every other thread is left long (see Fig. 2.22).
- e The long threads are tied over a foam bolster or Vaseline gauze to create a light pressure dressing (see Fig. 2.22).

Larger Scar Contractures Causing Lip Retraction

(Figs. 6.13 and 6.14)

The scar is excised, and the defect adjacent to the vermillion is repaired with a small transposition flap (Fig. 6.13a, b).

With contracture and distortion of the oral commissure, the scar is excised (Fig. 6.14a) and the angle of the mouth is raised with a Z-plasty (Fig. 6.14b).

Defects in the Nasal Floor and Upper Lip

Transposition Flap from the Nasolabial Fold

(Fig. 6.15)

Smaller defects in the nasal floor and upper lip can be covered with a small superiorly based or inferiorly based (Fig. 6.15a, b) flap. Large, inferiorly based transposition flaps provide better reach for reconstructing the nasal vestibule and portions of the columella (Fig. 6.15c).

Bilobed Flap

(Fig. 6.16)

Larger defects in this area are repaired with an inferiorly based bilobed flap from the cheek. The first lobe of the flap should cover the nasal floor and upper lip, and the ala should be correctly positioned without tension in the angle between the first and second lobes (Fig. 6.16b). A larger defect in the upper lip can be repaired with a full-thickness sliding flap (Fig. 6.17) or advancement flap (Fig. 6.18). In the latter case a crescent-shaped skin excision is made in the alar groove above the upper lip defect, the cheek skin is mobilized, and the flap is advanced into the defect (Fig. 6.18a,b).

For larger defects in the upper lip area, the incision can be extended along the orbital margin and down past the angle of the mouth to create a kind of U-flap (Fig. 6.19a) for covering the defect (Weerda and Härle 1981; Weerda and Siegert 1990; Fig. 6.19b; see also Imre cheek rotation in Fig. 5.25 and Imre-Esser cheek advancement in Figs. 8.2 and 8.4).

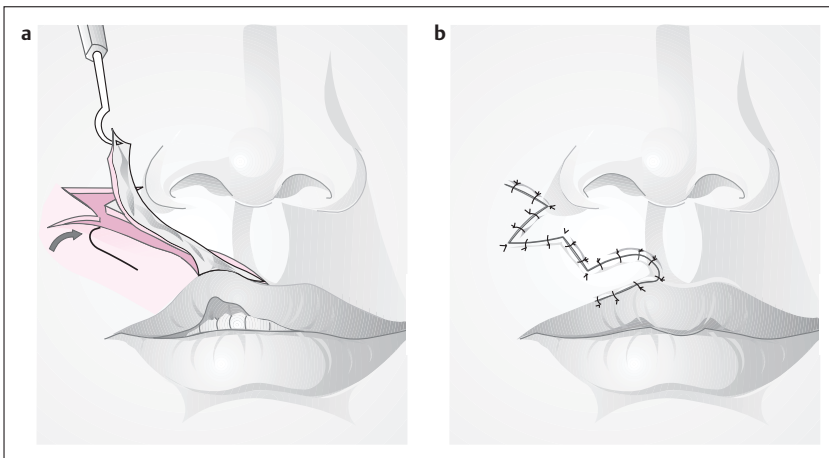


Fig. 6.13 Scar contracture causing lateral distortion of the upper lip.

- a The scar is excised. A small flap is mobilized, and a Z-plasty is performed (see Figs. 2.16 and 6.11).
- b The completed repair.

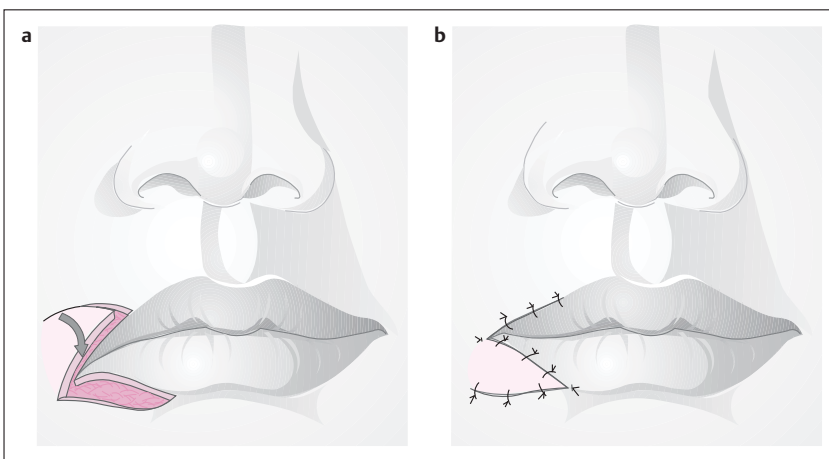


Fig. 6.14 Scar contracture with distortion of the commissure.

- a The scar is excised, and a triangular-shaped flap with a lateral base is outlined in the upper lip.
- b The flap is transposed and inset, raising the commissure to a normal level.

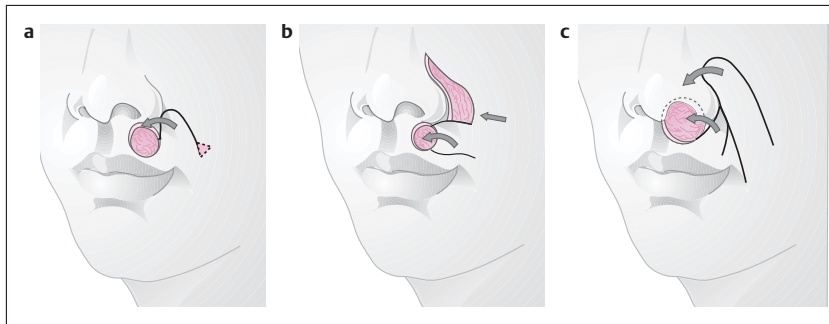


Fig. 6.15 **a, b** Various flaps for repairing a defect in the **nasal vestibule or upper lip**.

c A large, inferiorly based nasolabial flap can be used to repair a defect in the nasal vestibule. A small flap covers the defect in the columella.

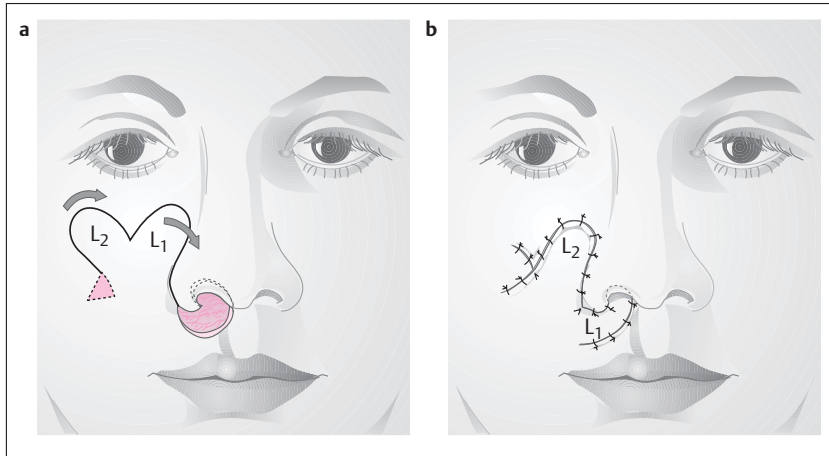


Fig. 6.16 Inferiorly based bilobed flap for repairing a defect in the **upper lip and nasal vestibule** (after Weerda and Härle 1981).

a Outline of the flap.

b The flap is rotated into place, and all defects are closed. The ala is located between lobes L1 and L2.

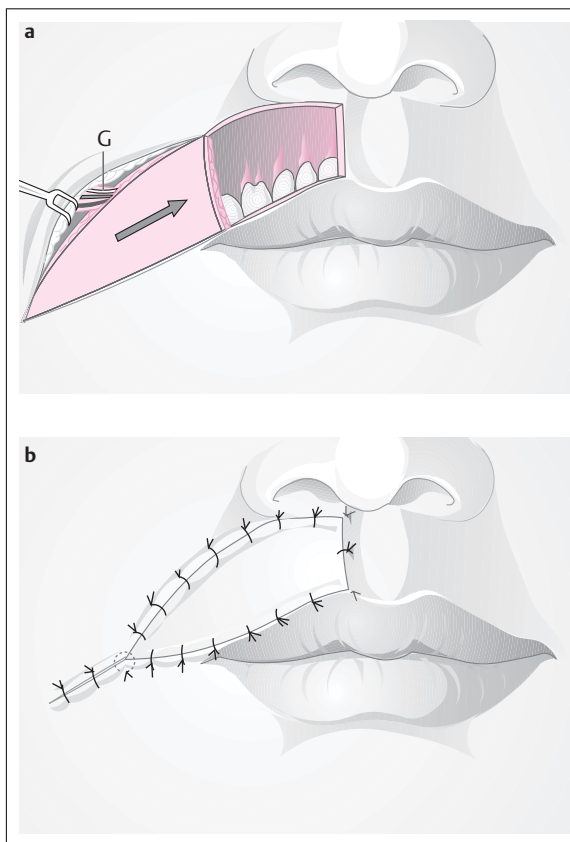


Fig. 6.17 **Neurovascular island flap** from the lower cheek (after Weerda 1980 d).

a The three-layered flap is advanced on a neurovascular pedicle (G = blood vessels plus a branch of the facial nerve).

b The completed repair (see Fig. 6.29).

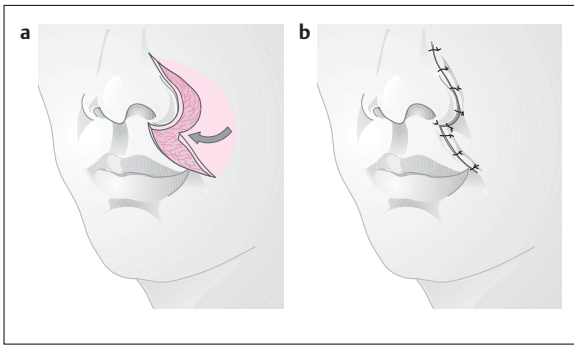


Fig. 6.18 Burow's laterally based **cheek advancement**.

- a For a defect in the upper lip, a crescent-shaped skin excision is made in the alar groove.
- b The cheek flap is advanced and all defects are closed.

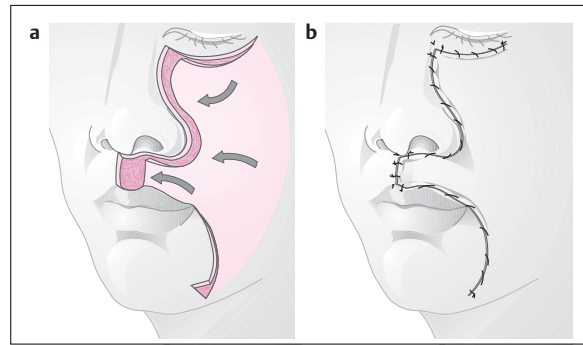


Fig. 6.19 **Modified cheek advancement** of Weerda et al. (1981, 1990).

- a The flap is cut and the cheek is mobilized, aided by a crescent-shaped excision in the area of the alar groove and lateral nose.
- b The completed repair.

Central Defects of the Upper Lip (Fig. 6.20)

As noted earlier (see Figs. 6.18 and 6.19), the classic reconstruction described by Celsus (ca. 25 A.D.) and Bruns (1859) (Fig. 6.20) can also be used to repair full-thickness defects of the upper lip. A perialar skin crescent is excised (Fig. 6.20a), and the mobilized cheek flap is shifted medially into the defect (Fig. 6.20b).

Celsus Method Combined with an Abbe Flap

(Fig. 6.21; see also Figs. 6.20 and 6.22)

Large defects of the upper lip can be repaired by closing or reducing the central defect by the Celsus method (Figs. 6.20 and 6.21a) and then using a three-layered Abbe flap from the lower lip (Figs. 6.21b, c, and Fig. 6.22) to replace the central part of the upper lip (Fig. 6.22a, b). In a second stage about 3–4 weeks later, the turnover flap is detached from the lower lip and the wounds in the upper and lower vermillion are closed (Fig. 6.21c).

Classic Reconstructive Techniques in the Upper Lip

Abbe Flap (1898)

(Fig. 6.22)

Moderate-sized defects of the upper lip can be repaired by transposing a wedge-shaped flap from the lower lip based on the inferior labial artery. The Abbe

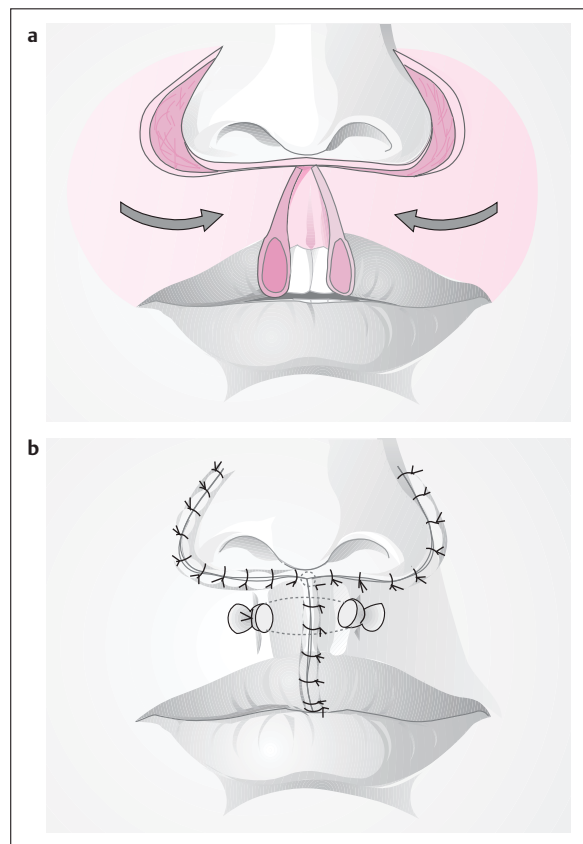


Fig. 6.20 **Upper lip reconstruction** by the method of Celsus (ca. 25 A.D.) and Bruns (1859).

- a A two-layer, crescent-shaped excision is made lateral to the alar groove, and the incision is extended along the nasal base. (For larger defects, the mucosa is mobilized.)
- b The completed repair.

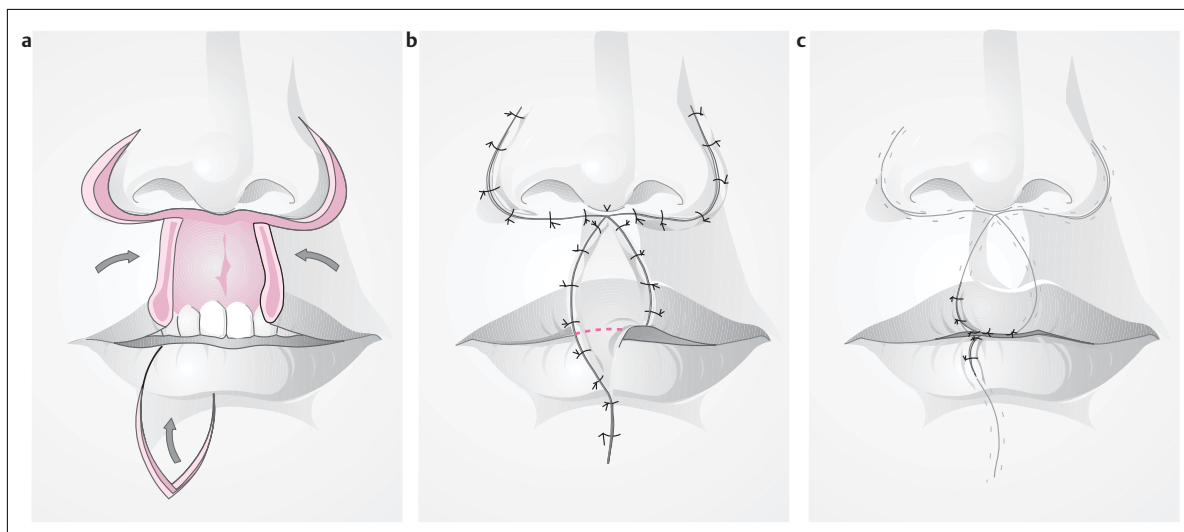


Fig. 6.21 **Upper lip reconstruction** by the method of Celsus (ca. 25 A.D.) and Abbe flap (1898).

a Mobilization of the upper lip (see Fig 6.20) and three-layered incision of the Abbe flap (see Fig 6.22).

b The Abbe flap is rotated into the upper lip defect.

c About 20 days later the pedicle is divided and the small lip defects are closed.

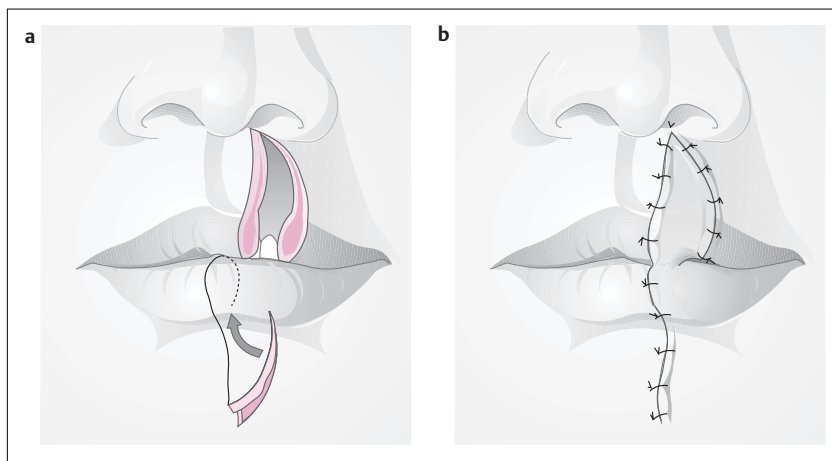


Fig. 6.22 **a, b Three-layered Abbe flap** (1898) from the lower lip (see also Figs. 6.23 and 6.24).

a Incision of the three-layered Abbe flap in the lower lip.

b Rotation of the Abbe flap into the upper lip defect. The flap is divided about 20 days later

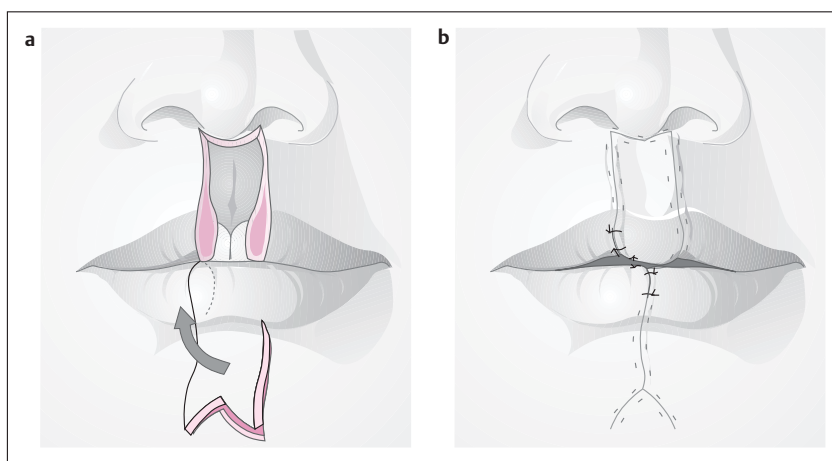


Fig. 6.23 **Modification of the Abbé flap** (Converse 1977; see Figs. 6.22 and 6.24).

„lip switch“ is particularly useful for reconstructing defects associated with a cleft lip or the excision of a medially located tumor (Fig. 6.22a, b). About 16–20 days after the flap has been inset, its vascular pedicle is divided (see Fig. 6.21b, c). A prong-shaped flap can also be designed (Fig. 6.23; Converse 1977). A Z-plasty can be added to disperse the scar in the lower lip area (see Fig. 6.24d, e).

Estlander Flap (1872)

(Fig. 6.24)

A three-layer lip-switch flap similar to the Abbe flap can be used in the area of the oral commissure.

1. The flap is based on the commissure and is outlined in the lower lip area (Fig. 6.24a). It is rotated 180° and sutured into the wedge-shaped defect in the upper lip (Fig. 6.24b, c).

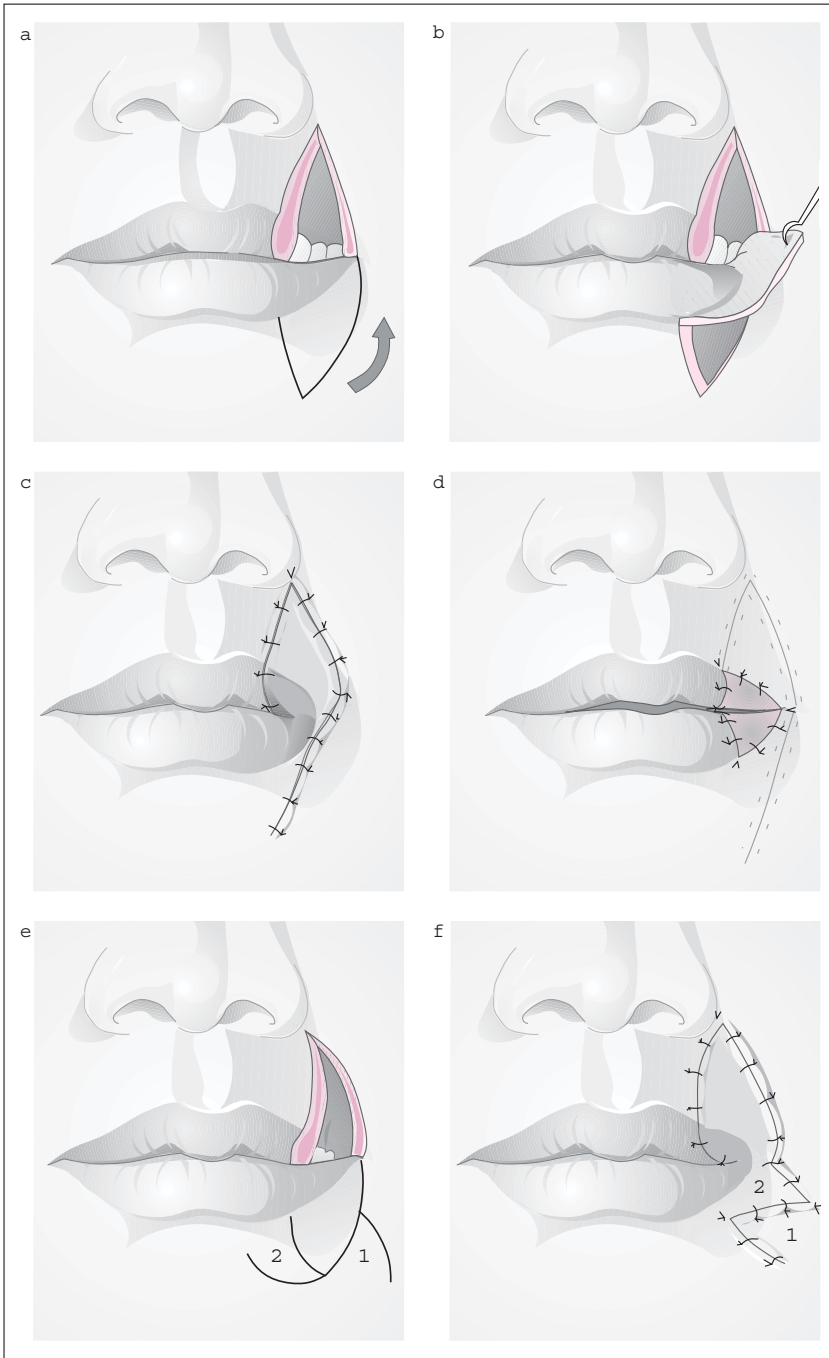


Fig. 6.24 The Estlander flap (1872) is similar to the Abbe flap used at the angle of the mouth. The wedge-shaped flap, based on the inferior labial artery, is rotated around the angle of the mouth into the defect.

- a The Estlander flap is cut through all layers of the lower lip.
- b The flap is rotated into the upper lip defect.
- c All defects are closed.
- d About 16–20 days later the pedicle is divided, the triangular mucosal flaps are mobilized, and the lip is closed (see Fig. 6.56).
- e, f A Z-plasty is added for closure of the donor site. The Estlander flap can also be used for lower lip reconstruction.

2. The pedicle is divided about 16–20 days later. If desired, revision of the rounded commissure can be done as a secondary procedure (Fig. 6.24d). Bilateral Estlander flaps can also be used.

Upper Lip Reconstruction with a Rotation Flap (Blasius 1840)

(Fig. 6.25)

A two-layer rotation flap can be cut from the cheek to reconstruct portions of the upper lip (Fig. 6.25a). The vermillion in that area can also be restored by pre-sewing the slightly mobilized mucosa of the upper oral vestibule to the flap (Weerda and Härle 1981; see Fig. 6.25b). A modification of this method is shown in Figs. 6.26 and 6.27.

Upper Lip Reconstruction by the Method of Dean et al. (1975) as Modified by Weerda (1990)

(Fig. 6.27)

Lining for the flap is created by mobilizing the mucosa or using a free graft from the tongue. The external defect is repaired with a bilobed flap from the cheek (Fig. 6.27b).

Gillies Fan Flap (1976)

(Fig. 6.28)

This is a three-layer nasolabial flap cut around the ala (Fig. 6.28a). It provides enough tissue to fully reconstruct the lip. The flap is nourished by the labial ves-

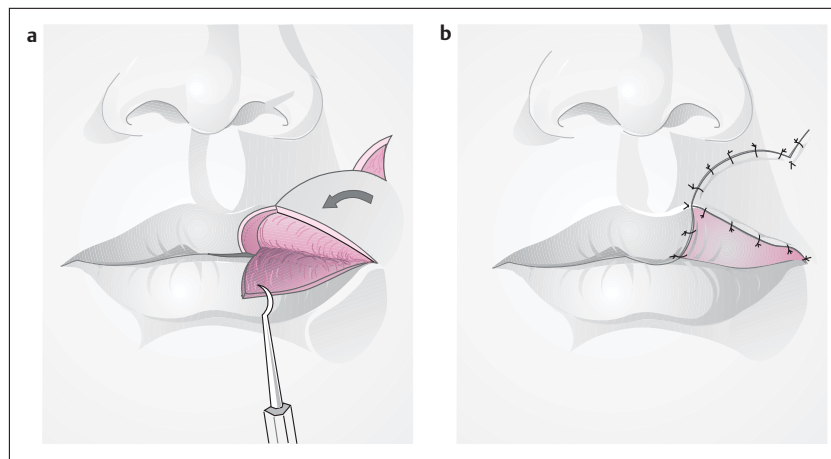


Fig. 6.25 Cheek rotation of Blasius (1840).

- a A two-layer rotation flap is cut from the cheek. The flap is slightly de-epithelialized in the area of the upper lip.
- b The vestibular mucosa is mobilized and sutured to the new upper lip.

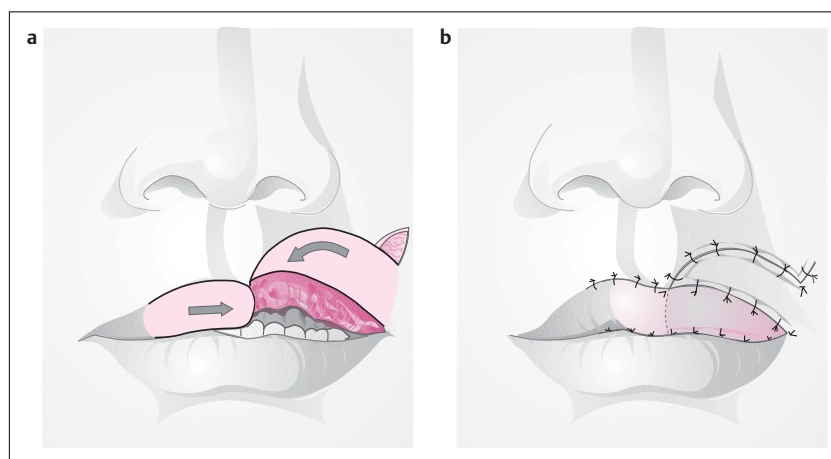


Fig. 6.26 Rotation flap of Blasius (1840). The vermillion is reconstructed by advancing the upper lip vermillion of the intact side.

- a Cutting the rotation flap and the mucosa of the lip stump.
- b The completed repair. (The rotation flap is epithelialized by advancing the upper lip vermillion (see Figs. 6.2 and 6.54).

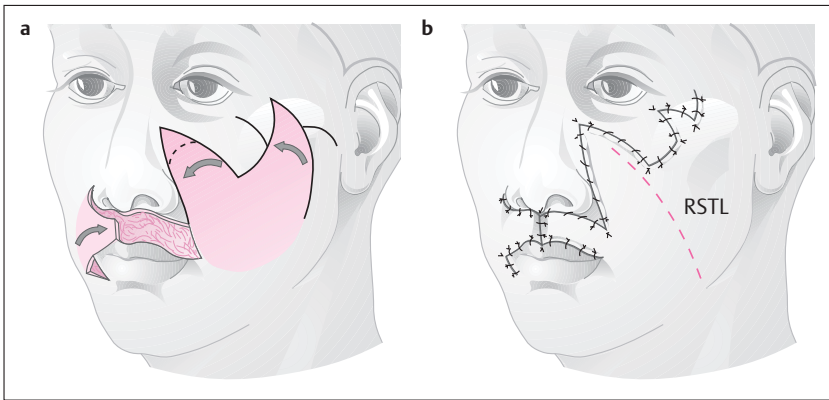


Fig. 6.27 Upper lip reconstruction of Weerda (see Fig. 6.20).

- a The left side is reconstructed with a two-layer bilobed flap.
- b The completed repair. A U-shaped cheek flap is advanced on the right side.

sels. The Gillies flap is usually cut in two layers, and the mucosa is mobilized toward the midline. The muscular ring around one or both commissures is rotated medially and closed (Fig. 6.28b, see also Fig. 6.45). A lateral Z-plasty gives the Gillies flap sufficient mobility (Fig. 6.28b). With a large defect, elongation of the oral fissure (see pp. 81, 82) may be done 3–4 weeks later as a secondary procedure.

Neurovascular Skin–Muscle–Mucosal Flap of Weerda (1980, 1990) (Figs. 6.17 and 6.29)

This flap is incised in three layers (Fig. 6.29a). The inferior labial artery and vein are dissected laterally in the cheek, then the mucosa is divided. The facial nerve branches are dissected and preserved. The three-layer skin–muscle–mucosal flap is then slid into the upper lip defect on its vascular pedicle, and the secondary wound is closed by mobilizing the surrounding skin (Fig. 6.29b, c). If part of the upper lip remains, the flap is incised downward at the commissure, portions of the upper lip mucosa are advanced medially, and the flap mucosa is flattened out to form the lateral mucosa of the upper lip(s). If cheek mobilization is not sufficient to close the secondary defect, Burow's triangles are excised to facilitate the closure (Fig. 6.29b).

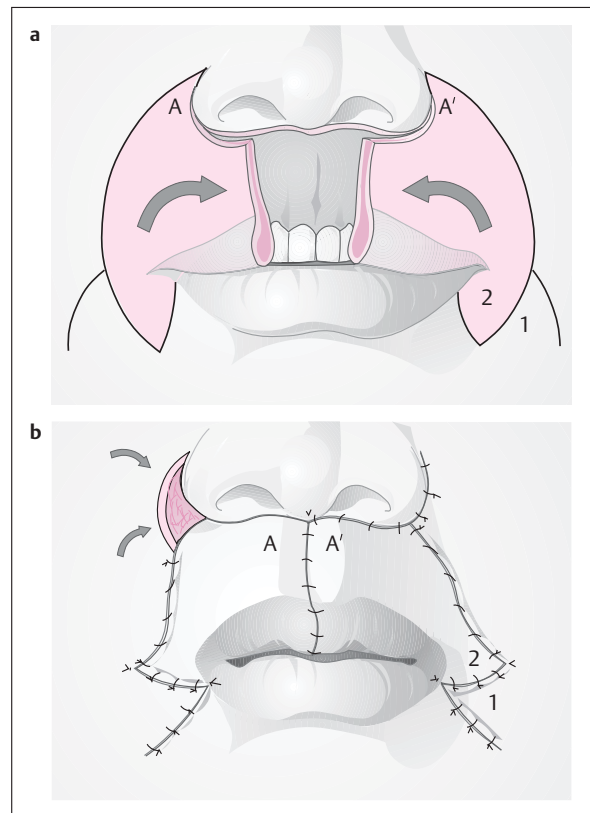


Fig. 6.28 Fan flap (Gillies 1976).

- a The flap contains the orbicularis oris muscle. It is dissected bluntly to preserve the superior and inferior labial vessels (see Fig. 6.29).
- b The completed repair (see text).

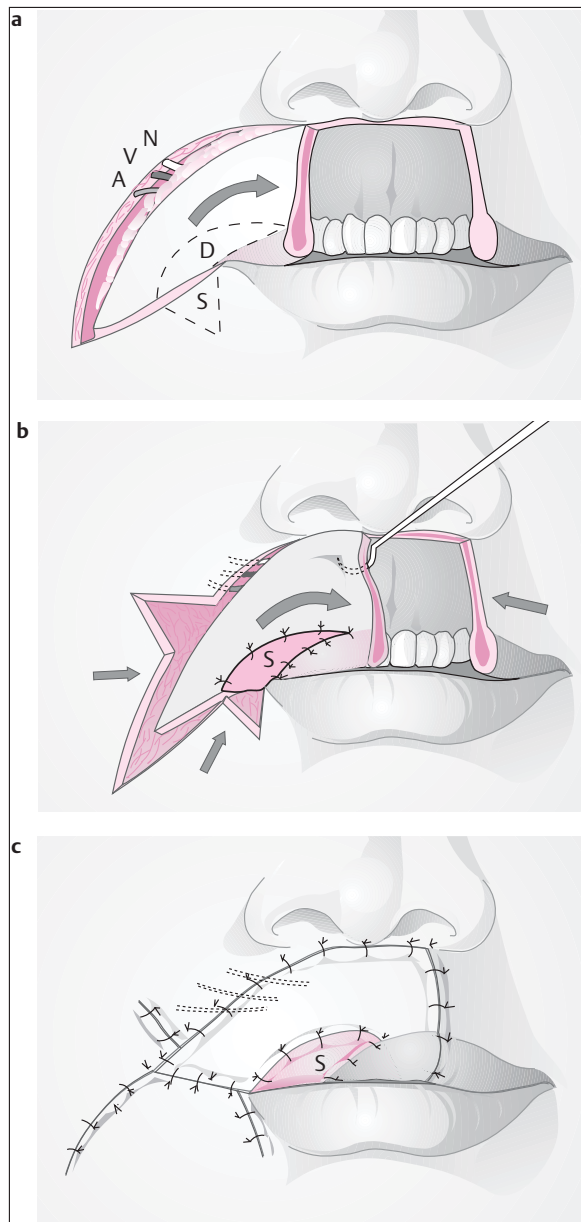


Fig. 6.29 **Neurovascular myocutaneous island flap** of Weerda (1981, 1990; see Fig. 6.17).

a The flap can be cut in two layers (with mobilization of the cheek mucosa) or three layers, preserving its neurovascular pedicle.

A = superior labial artery

V = vein

N = facial nerve

b The flap is advanced into the upper lip defect, and Burow's triangles are excised.

c The completed repair

S = mucosal flap from the oral vestibule;

D = de-epithelialized area.

Lower Lip

Scar Contractures and Small Defects

Small Contractures

(Figs. 6.30 and 6.31)

A small scar contracture can be managed by excising the scar and using a Z-plasty to disperse the new scars and orient them along RSTLs (Fig. 6.30). If contracture is not present, the defect can be repaired with a small transposition flap (Fig. 6.31).

Larger Contractures

a) Burn with ectropion of the lower lip (Fig. 6.32)

A small contracture causing ectropion of the lower lip can be dispersed with one, two, or more Z-plasties to lengthen the lower lip and restore the everted vermilion to a normal position (Fig. 6.32b).

b) Severe burns

A more severe contracture with fixation of the lower lip and destruction of the underlying skin can be managed much as in the upper lip (see Fig. 6.12) by excising the scar and then mobilizing the vermilion

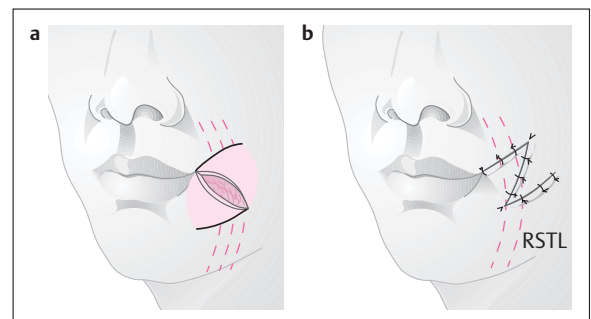


Fig. 6.30 **a, b** Excision of a **scar at the commissure**. A Z-plasty is used to disperse the scars and place them in the RSTLs.

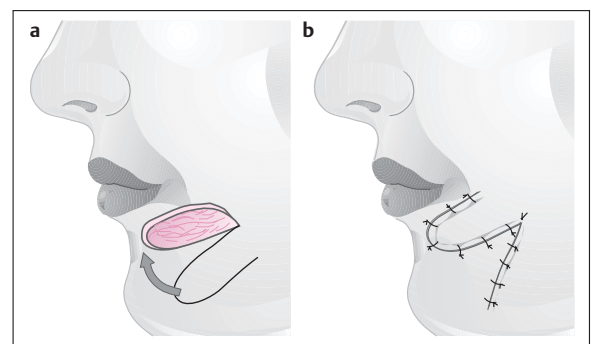


Fig. 6.31 **a, b** **Defect closure** with a transposition flap.

and shifting it upward. After making a pattern, we cover the defect with a full-thickness retroauricular skin graft (see Fig. 6.12c). The repair should be immobilized with a tie-over dressing for approximately 1 week (see Fig. 6.12d).

Small Defects

In small defects with scar contracture (Fig. 6.33a), the scar is excised and the defect closed by the V-Y method. The first suture (Fig. 6.33a, b) is used to

obtain precise coaptation of the skin-vermilion border.

Lip Reduction

Protuberant lips can be reduced by an intraoral mucosal resection (Fig. 6.34a, b) to decrease the size of the visible vermilion and thus narrow the lips. Since the scars are intraoral, they cannot be seen (Fig. 6.34c).

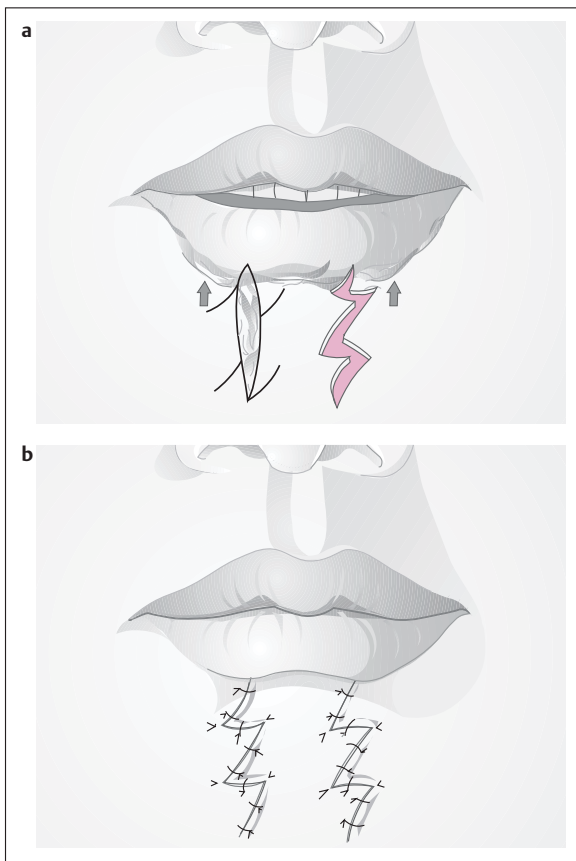


Fig. 6.32a, b The vermilion is stretched out to its normal length by excising the scars and performing multiple Z-plasties.

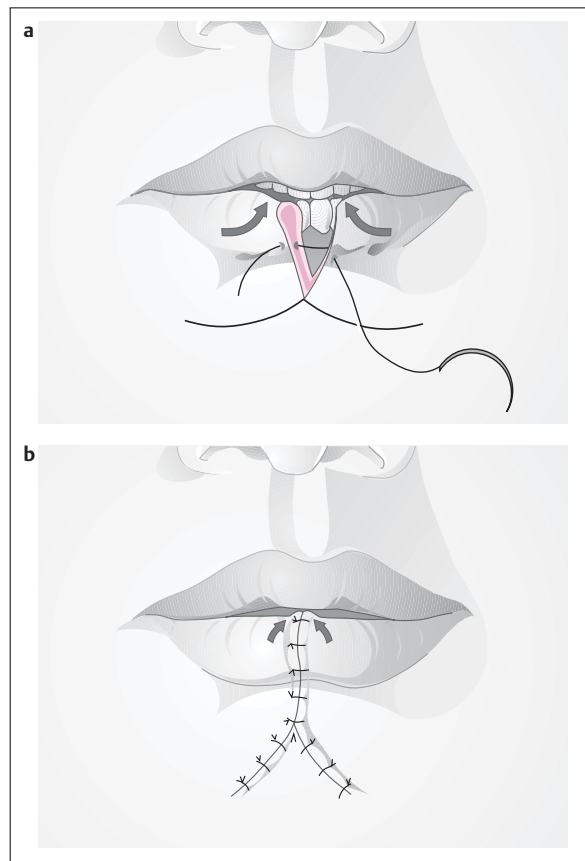


Fig. 6.33a, b **Small defect of the lower lip** with scar contractures repaired by a V-Y closure. Excess tissue should be provided in the vermilion area to prevent formation of a new defect after the scars have contracted.

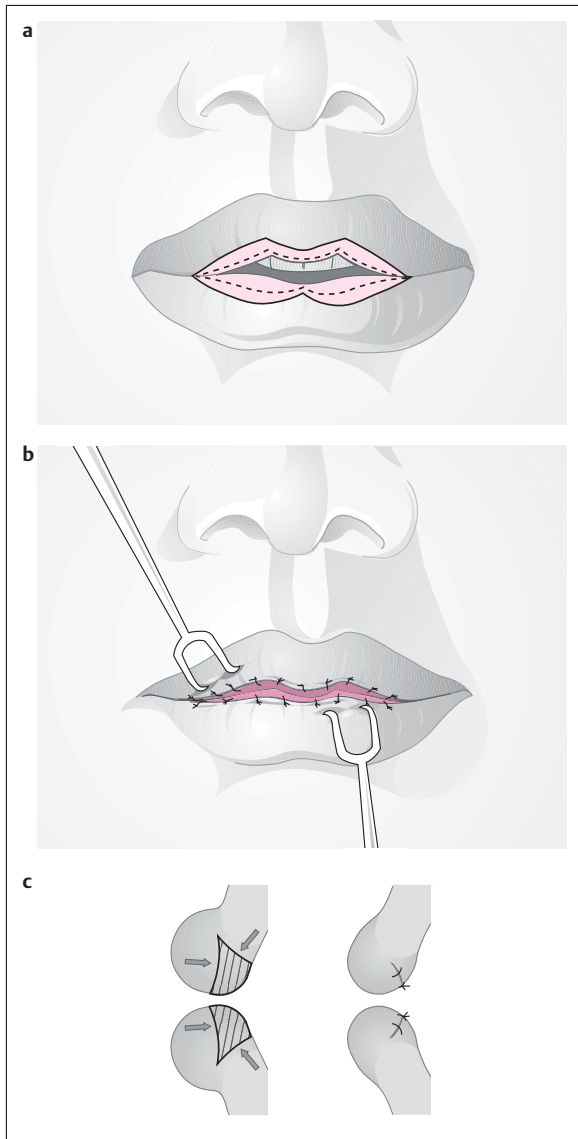


Fig. 6.34 Lip reduction.

- a Mucosa and some muscle tissue are excised intraorally from the protuberant lips.
- b All defects are closed, thinning the lips.
- c Cross-sectional view.

Sliding Flaps in the Vermilion

A kind of V-Y advancement can be used within the vermilion to repair defects of varying shapes (Fig. 6.35). Bilateral advancements can also be used (Fig. 6.36). The angle of the mouth can be moved upward by transposing a Z-flap (Fig. 6.37).

Classic Lower Lip Reconstructions

Approximately 90% of all lip tumors occur in the lower lip. It is important, therefore, to obtain a good esthetic and functional result when repairing small and large defects of the lower lip.

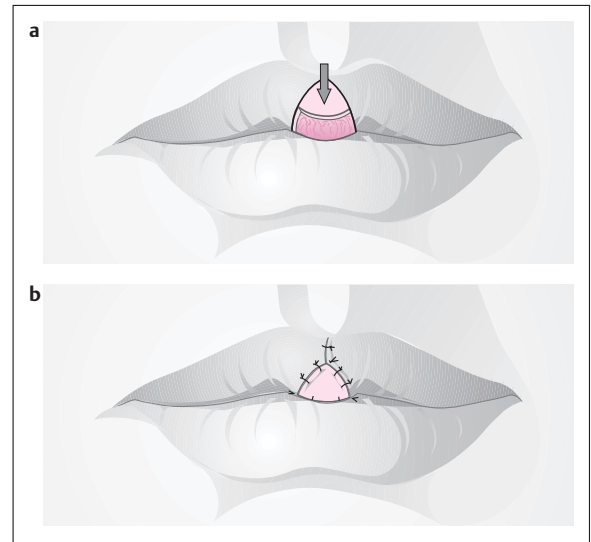


Fig. 6.35a, b V-Y closure of a small lip defect using a sliding flap.

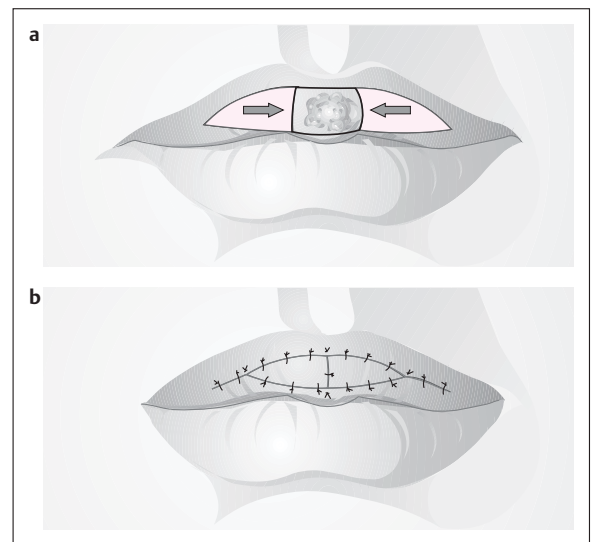


Fig. 6.36a, b V-Y closure of a defect using two sliding flaps.

Wedge Excision (Fig. 6.38)

Tumors that require excising up to one-third of the lower lip can be removed by a wedge excision. The sides of the excision should curve outward (heart-shaped excision, Fig. 6.38a); this creates a slight tissue excess along the suture line that will prevent notching after the scar has matured. The wound is closed from inside to outside (Fig. 6.38b), using a special stay suture (Fig. 6.38c, A) to coapt and align the vermilion. The muscle stumps are approximated separately with absorbable sutures (M). Various types of incision can be used to close these defects (Figs. 6.39 and 6.40).

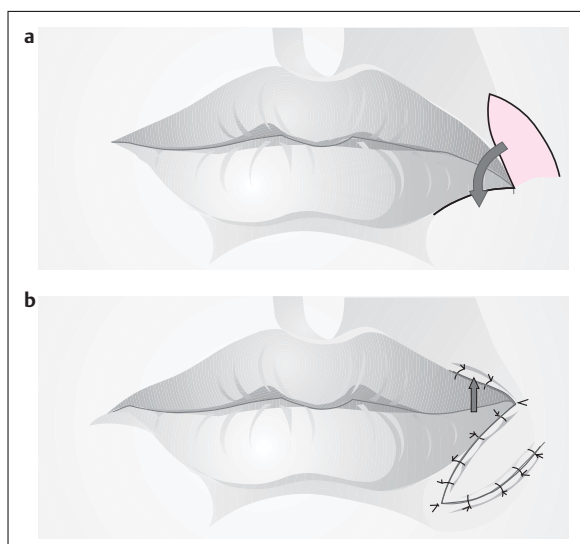


Fig. 6.37 **a, b** Z-plasty used to raise the angle of the mouth.

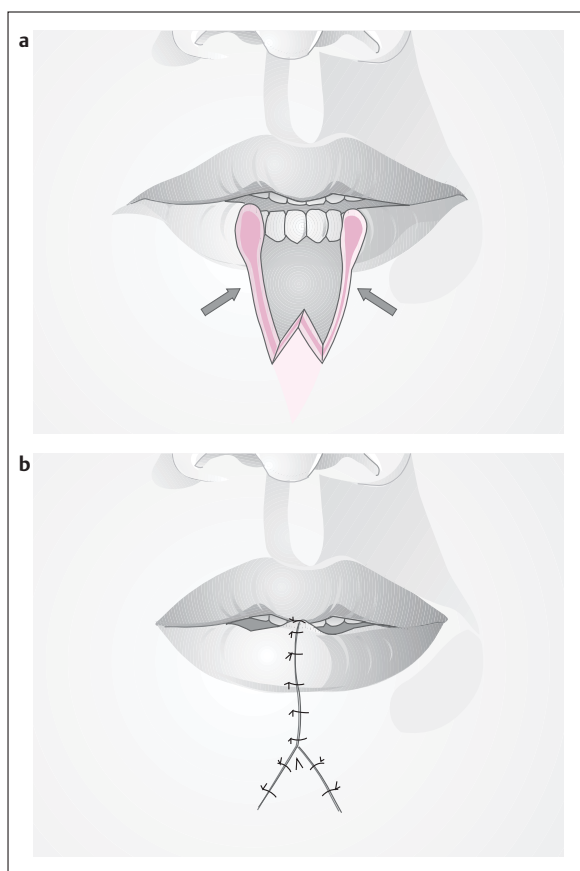


Fig. 6.39 **a, b** Modifications of the wedge excision.

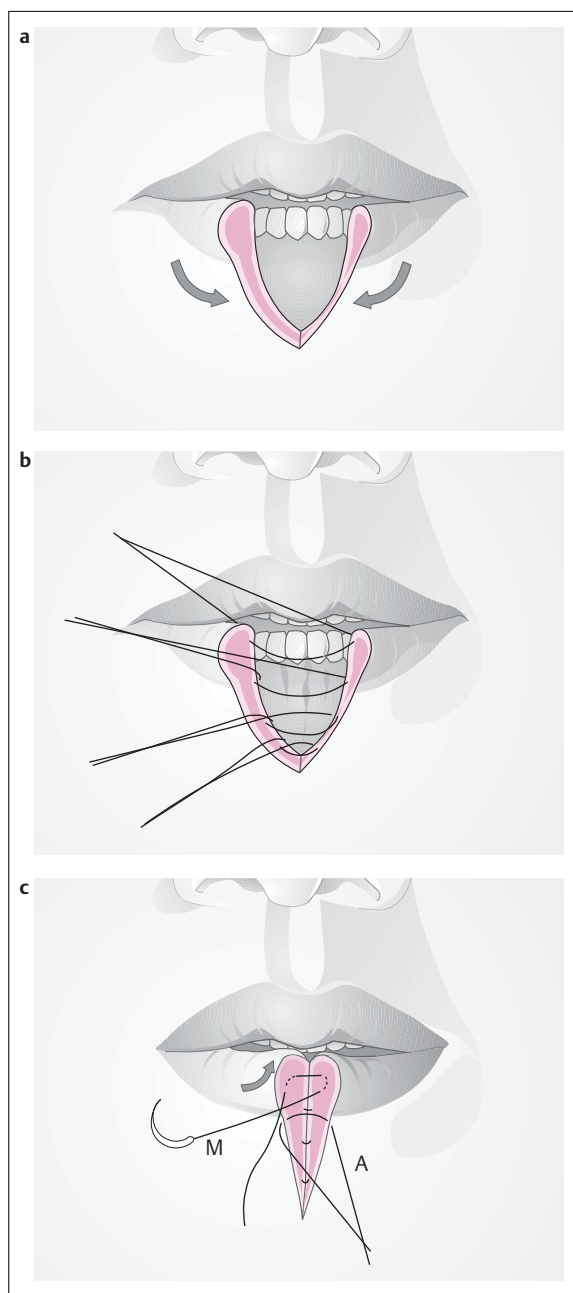


Fig. 6.38 **a** Heart-shaped wedge excision from the lower lip (up to one-third).

b The mucosa is closed first.

c Then the muscle edges are approximated with absorbable sutures (M).

A coapting suture is placed at the skin-vermilion border (A).

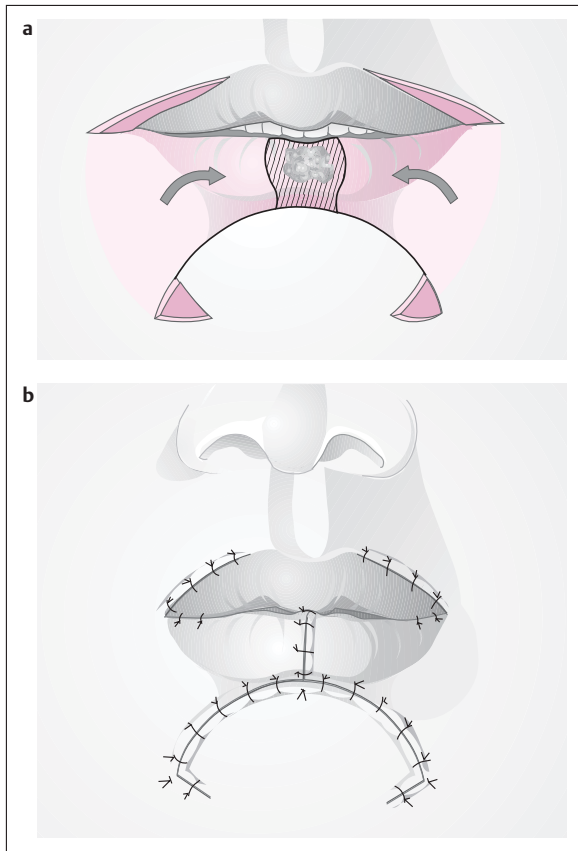


Fig. 6.40 Mobilization of the lip stumps (see Fig. 6.47). The stumps are mobilized by excising Burow's triangles lateral to the upper lip and chin.

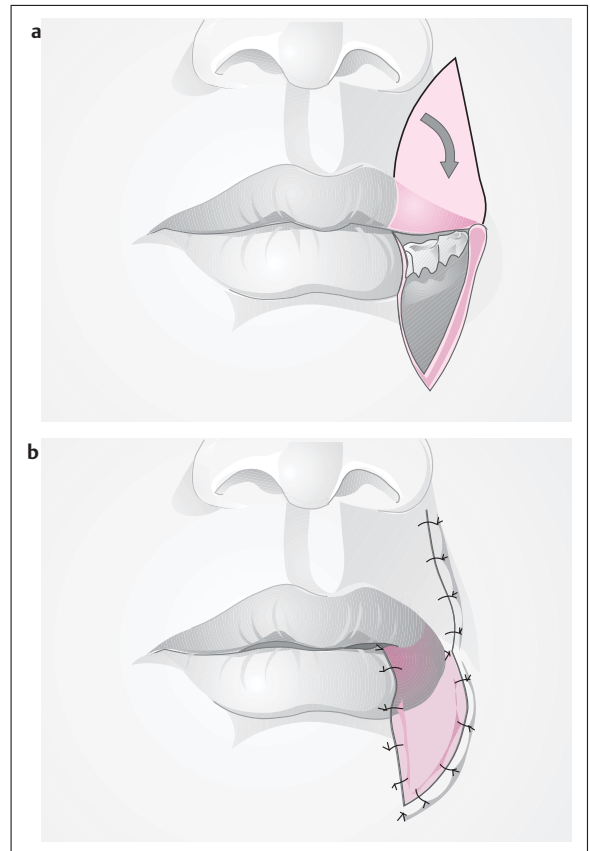


Fig. 6.41 Lateral lower lip reconstruction of Estlander (1872).

- a** A three-layer triangular flap is outlined in the upper lip down to the vermilion border, preserving the superior labial artery of the other side. The medial limb of the flap is convexly curved. The lateral limb extends to the commissure roughly along the nasolabial fold.
- b** The Estlander flap is rotated into the defect, bringing the lateral vermilion downward, and sutured in three layers (see Fig. 6.38). Revision of the rounded commissure may be necessary as a secondary procedure (see Figs. 6.24, 6.55–6.58).

Estlander Flap (1872)

(Fig. 6.41)

Lateral defects can be covered with a three-layer Estlander flap based on the superior labial artery. The flap is raised from the upper lip and rotated around the angle of the mouth. This transfer shortens the oral fissure, especially when bilateral flaps are used, making it necessary to elongate the oral fissure as a secondary procedure (see Figs. 6.24, 6.54, and 6.57). The Estlander technique can be used in a variety of modifications and combinations (see Fig. 6.43).

Vermilion Reconstruction by the Method of von Langenbeck (1855)

(Fig. 6.42)

The usual treatment for actinic damage of the lower lip with premalignant changes is to remove the entire vermilion of the lower lip. The mucosa lining the oral vestibule is then mobilized and advanced to resurface the lip with an excellent cosmetic result. The skin–vermilion border is carefully restored using 6–0 or 7–0 monofilament, which is removed on the fifth or sixth day (Fig. 6.42b). In all lip reconstructions, the mucosal surface of the lip should be coated with

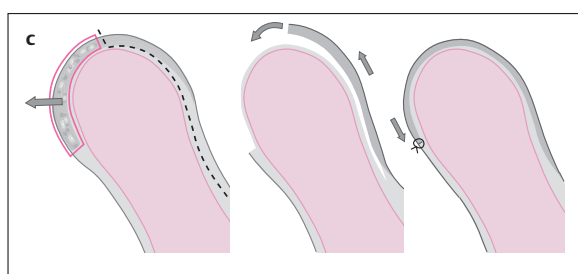
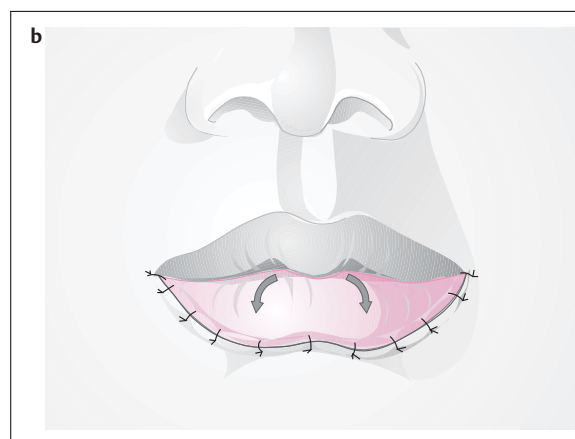
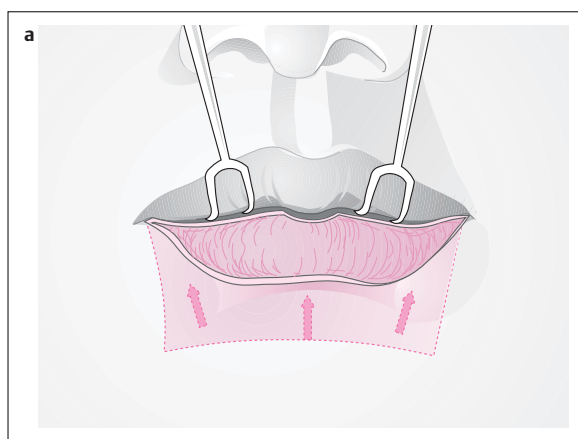


Fig. 6.42 **Vermilion reconstruction** by the method of von Langenbeck (1855).

- a** The premalignant vermilion has been completely resected. The mucosa of the oral vestibule is mobilized, advanced over the raw surface, and sutured into place.
- b** Closure of the defect.
- c** Cross-sectional view of the operation.

petroleum jelly to keep it from drying out. The resurfaced lip shows an initial livid discoloration that looks dangerous but is usually harmless and should clear within a few days.

Tongue Flap (Fig. 6.43)

The resected vermilion can also be replaced with a tongue flap. This flap may be raised from the tip of the tongue (Fig. 6.43a, b) or tongue margin and is sutured to the skin resection margin of the lip. Its pedicle is divided 17–20 days after the initial transfer.

Brown Modification of the Estlander Flap (1928) (Fig. 6.44)

An Estlander flap can also be used for larger medial defects involving more than one-third of the lower lip. The defect created by the wedge excision (Fig. 6.44a) is covered by making a three-layer incision through the lower lip at the commissure and advancing the lip into the defect (Fig. 6.44a, b). A superior Estlander flap is then used to close the remaining lateral defect (Fig. 6.44c, d).

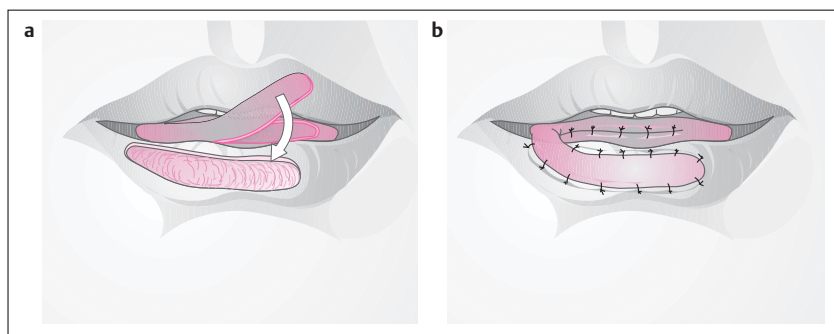


Fig. 6.43 **a, b The tongue flap.**

- a** A mucosal flap from the anterior margin of the tongue, based on the right or left side, is swung into the defect.
- b** The lip and tongue defects are closed. The pedicle is divided about 3 weeks later, and the residual defects in the lip and tongue are closed.

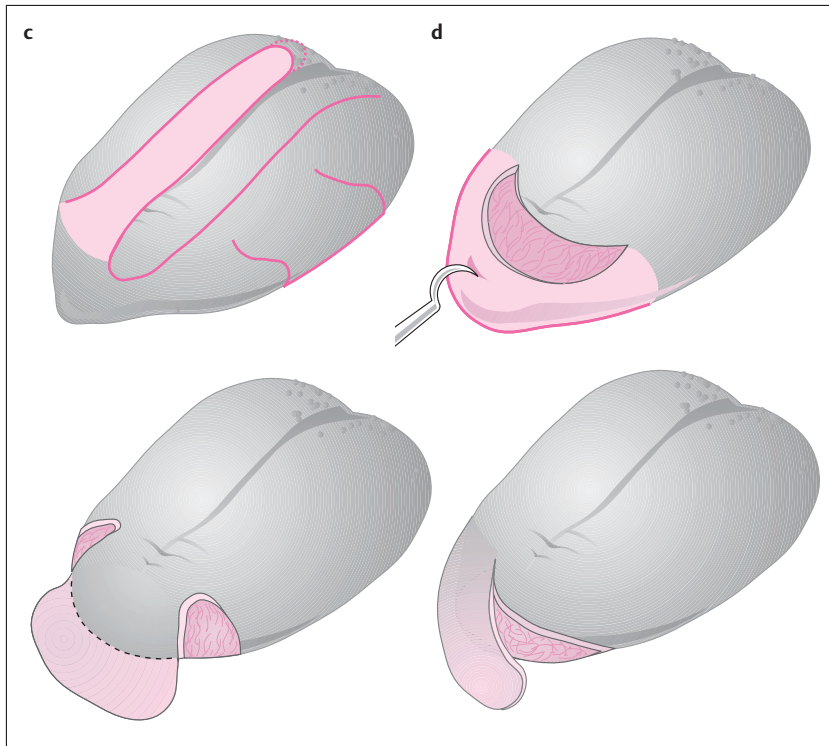


Fig. 6.43 **c, d**
Other potential donor sites for
tongue flaps.

**Unilateral or Bilateral Gillies
Fan Flap**
(Fig. 6.45)

As in the upper lip (see Fig. 6.28), a large defect of the lower lip can be reconstructed by rotation of the orbicularis oris muscle as originally suggested by Bruns (1859) and Ganzer (1917) (Fig. 6.45a). This flap, called the Gillies fan flap, is raised by incising through the full thickness of the oral vestibule, then upward into the cheek and back toward the commissure, so that the upper portion resembles a short Estlander flap (Fig. 6.45a, 1). Z-flaps at the top of the flap are transposed, and the whole flap is rotated into the defect (Fig. 6.45b).

The wound is then closed in layers from inside to outside, using separate sutures to approximate the orbicularis oris muscle. As in other procedures, care is taken to avoid a stepoff at the skin-vestibule border of the lower lip. When bilateral flaps are used, the angles of the mouth will have to be revised in a later sitting (see Figs. 6.55 and 6.58). We like to use a binocular loupe for preparation.

**Universal Method of Bernard (1852),
Grimm (1966), and Fries (1971)**
(Fig. 6.46; unilateral or bilateral)

Bernard (1852) described an operation, repeatedly modified during the past century, for unilateral or bilateral reconstruction of the lower lip. Placing the incisions and Burow's triangles in the lines of the esthetic units yields a very good cosmetic result with acceptable mobility and width of the reconstructed lip. A turnover flap of cheek mucosa (S) is raised to restore the vermillion on the opposing de-epithelialized portion of the reconstruction flap (D) (Fig. 6.46a-c). Cutting along the nasolabial folds can give the mouth a froglike appearance, however, and so we prefer to cut from the angle of the mouth to the alar groove (Fig. 6.46c, d; see also Fig. 6.40). Meyer (1962) described a modification of the technique (Fig. 6.47a, b).

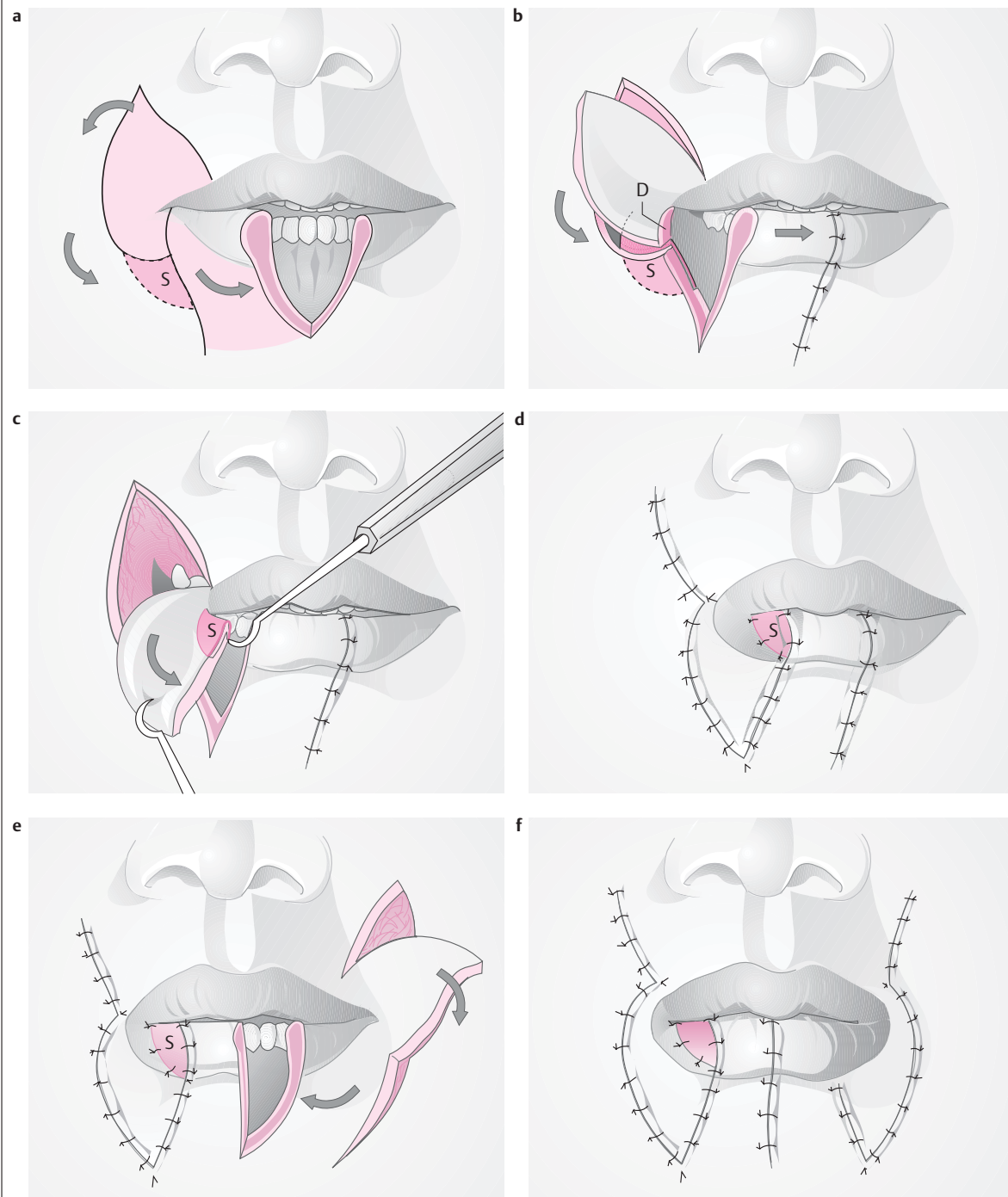


Fig. 6.44 **Modified Estlander flap** (Brown 1928; Kazanjian and Converse 1974).

- a** Large median defect of the lower lip. The lateral lower lip is incised through all three layers. Note the outline of the Estlander flap, which is incised just to the mucosa inferiorly, where a small mucosal flap (S) is raised.
- b** The lateral lip segment is slid medially into the primary defect and sutured in three layers (see Fig. 6.38).
D = defect (new vermilion)

- c** The lateral lip defect is closed with the Estlander flap (see Fig. 6.41), which is rotated into place.
The small vermilion defect is covered with the mucosal flap (S).
- d** All defects are closed.
- e, f** Modification preserving the angle of the mouth (left side; Weerda and Härle 1981).

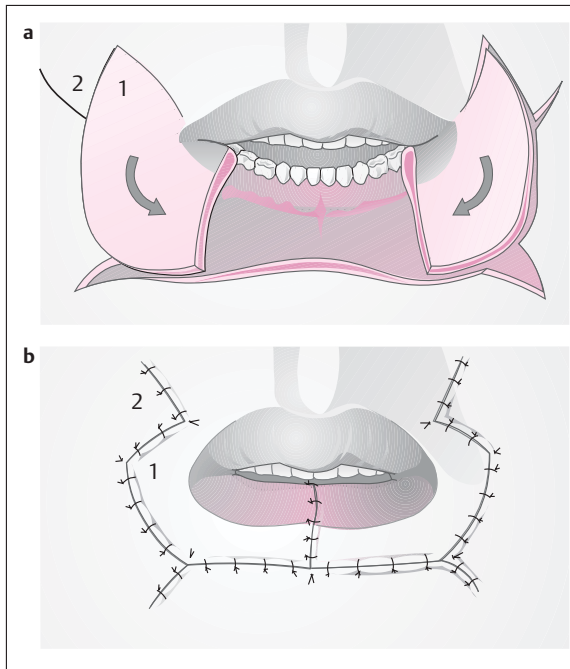
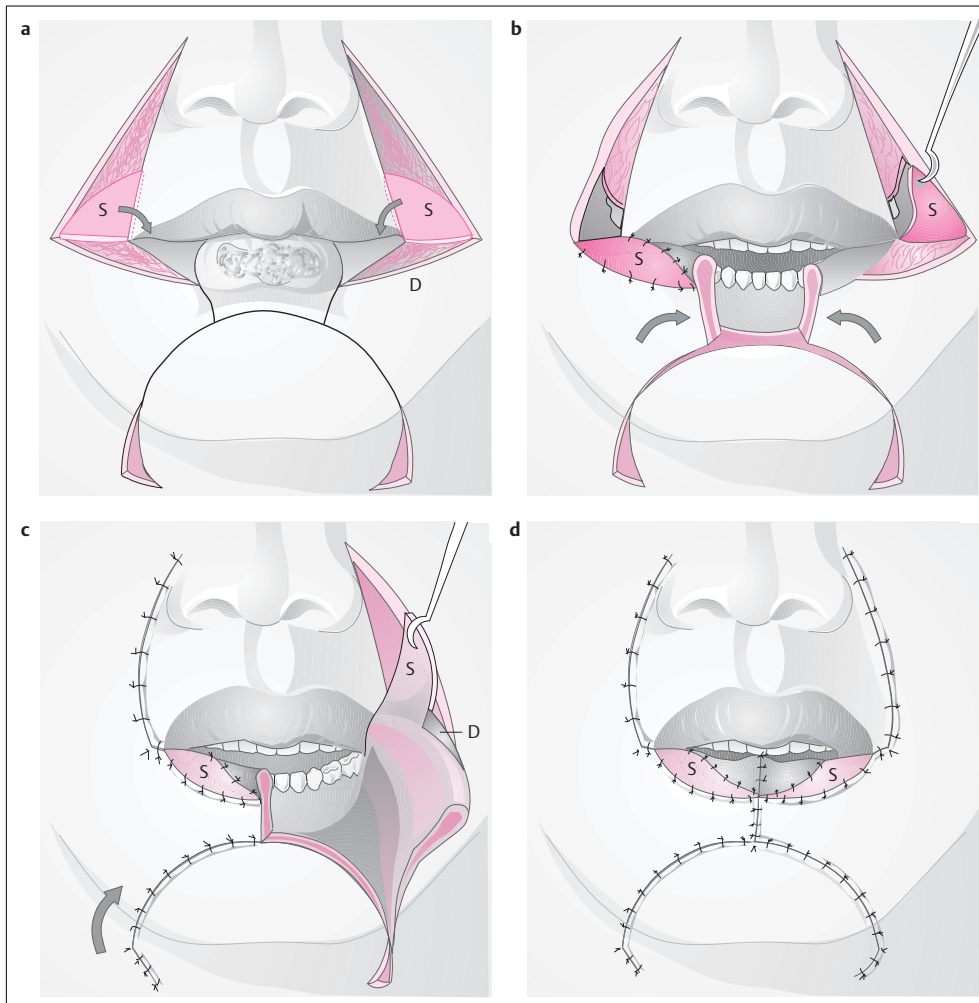


Fig. 6.45 Unilateral or bilateral Gillies fan flap (1957).

- a The fan flap is basically a large two-layered Estlander flap that is rotated around the orbicularis oris muscle, if possible maintaining its neurovascular supply (see Fig. 6.29). A large Z-plasty (1 + 2) extends the reach of the flap. If necessary, Burrow's triangles are excised to help close the defects.
- b Appearance after flap transposition and closure of all defects (see Fig. 6.28).

Fig. 6.46 Lower lip reconstruction by the universal method of Bernard (1852), Grimm (1963), and Fries (1971).

- a For a subtotal defect of the lower lip, the lateral cheek is mobilized by incising the commissure and excising two-layer Burrow's triangles lateral to the commissures. A portion of the cheek U-flap is de-epithelialized (D) and resurfaced with a mucosal flap (S) from the cheek.
- b The tumor has been resected. The cheek U-advancement flap has been raised, on the left side the mucosal flap (S) is raised, and on the right side it has been sutured into place.
- c The right side has been closed and the left side mobilized.
- d The completed repair.



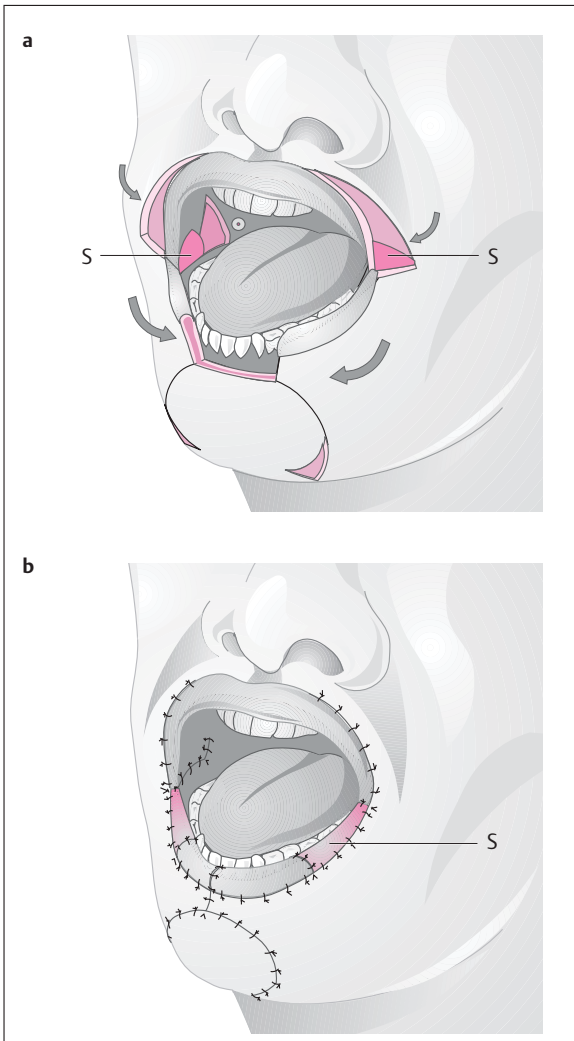


Fig. 6.47 **Meyer's modification**

- a** The triangles are cut lateral to the upper lip, and the cheek mucosa is incised and mobilized to cover the upper lip defects. Burow's triangles are excised in the cheek skin, turnover flaps of the cheek mucosa (S) are incised to restore the lateral vermillion defects.
- b** The completed repair.

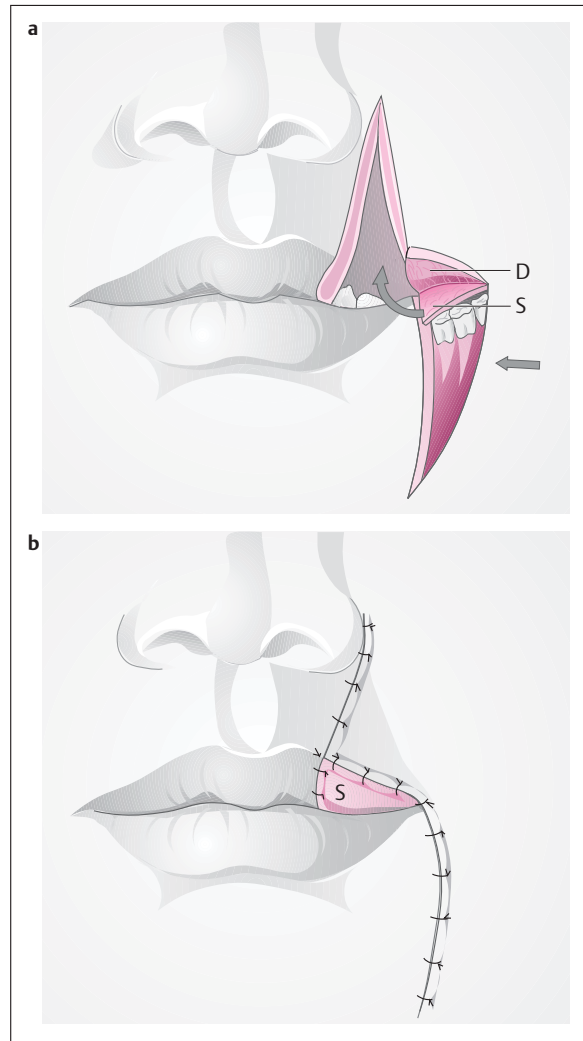


Fig. 6.48 **Lateral lip reconstruction** by the method of Burow and Zisser.

- a** Burow's triangle after tumor excision. The flap is transposed by cutting a three-layer Burow's triangle lateral to the lower lip. D = de-epithelialized area
- b** As in previous reconstructions, a flap of cheek mucosa (S) is used to resurface the de-epithelialized area.

Reconstruction of the Lateral Lip and Commissure

Burow's Method of Reconstructing the Lateral Upper Lip (1855)

(Fig. 6.48)

Following the wedge excision of a tumor of the lateral upper lip (Fig. 6.48a), that part of the lip and

the commissure can be reconstructed by a simple advancement technique following the excision of a Burow's triangle next to the lower lip. A mucosal flap raised adjacent to the lower lip (Fig. 6.48a, S) is used to resurface the de-epithelialized area (D) on the reconstruction flap. This restores an acceptable length to the oral fissure and yields a good cosmetic result (Fig. 6.48b; Zisser 1970). Brusati (1979) proposed a similar reconstruction for both commissures (Fig. 6.49).

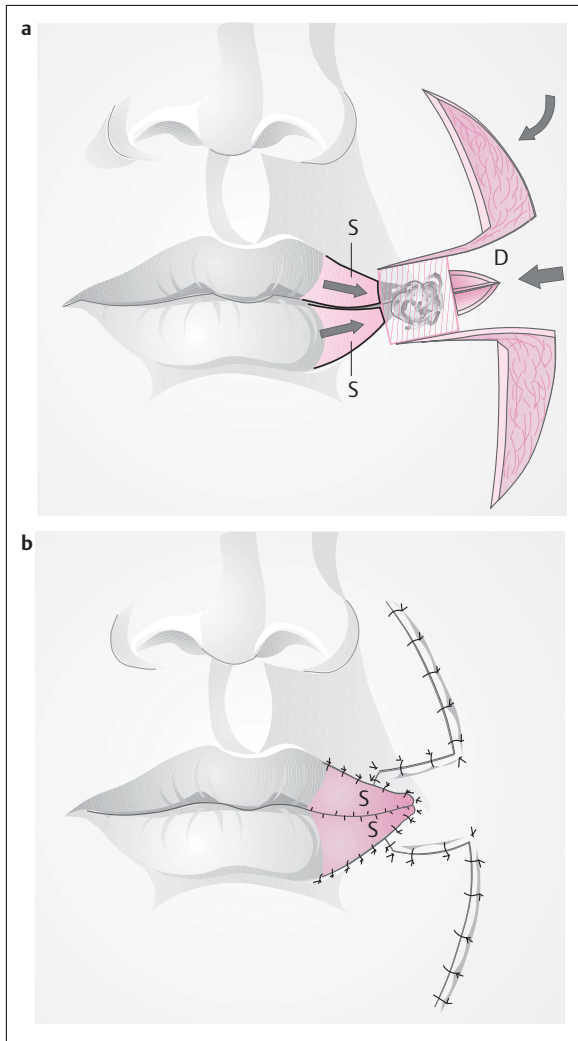


Fig. 6.49 **Reconstruction of the commissure** by the method of Brusati (1979).

- a The commissure is resected. Two Burow's triangles are excised from the cheek, and the cheek U-flap is advanced medially. A small area of the flap at the commissure is de-epithelialized (D).
- b The lip mucosa is mobilized and advanced (S) into the de-epithelialized area (D).

Reconstruction of the Commissure by the Method of Rehn (1933) as Modified by Fries (1971) and Brusati (1979) (Fig. 6.50)

When the commissure must be resected along with portions of the lateral upper and lower lip (Fig. 6.50a), the incisions are placed on a roughly semicircular segment in the cheek above and below the lips. The secondary defects can be closed by the excision of Burow's triangles. The commissure is re-

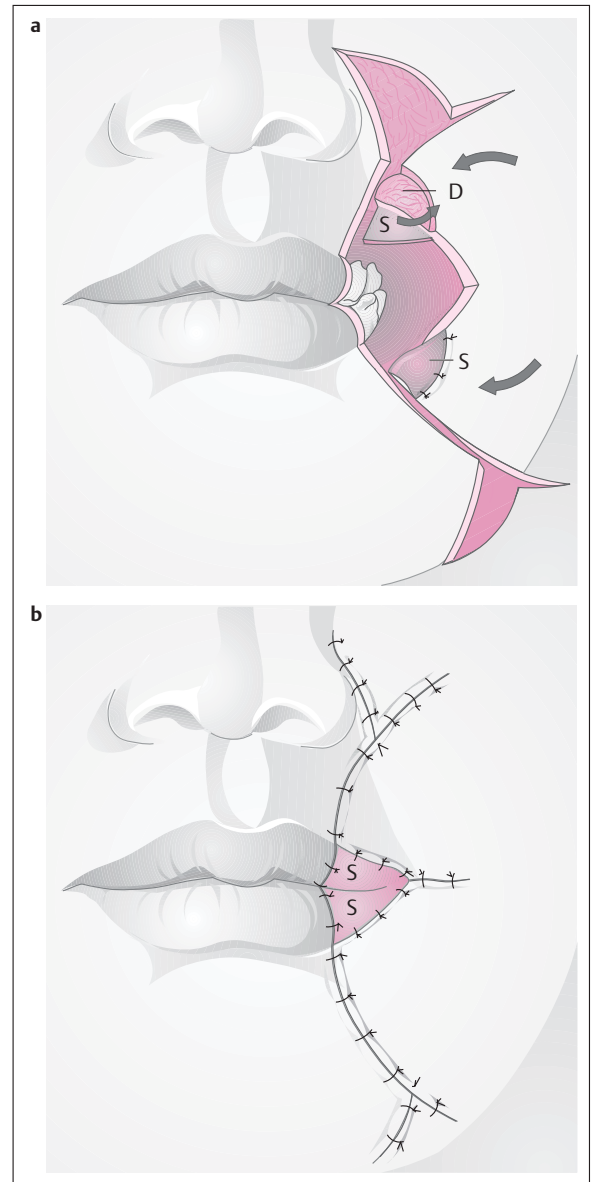


Fig. 6.50a, b **Reconstruction of the commissure** by the method of Fries (1973) and Brusati (1979). If intraoral mucosa is not available, the vermillion can be mobilized and advanced (see Fig. 6.55).

stored by suturing small triangular mucosal flaps (S) to corresponding de-epithelialized sites on the flap (Fig. 6.50, D). (Vermilion advancement can also be used; see Fig. 6.55.)

Reconstruction of Large Commissural Defects (Fig. 6.51)

As in the previous reconstruction, a two-layer trapezoidal flap is cut above and below the defect, and the

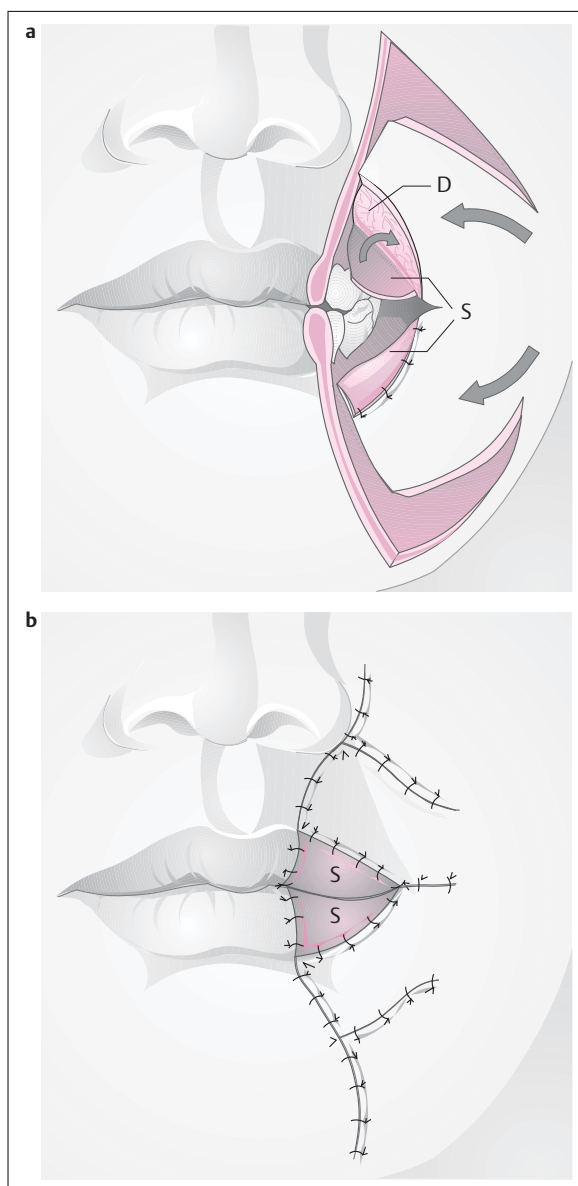


Fig. 6.51 **a, b** Reconstruction of the commissure by dual V-Y advancement. (Vermilion reconstruction see Figs. 6.48–6.50.)

vermilion is restored by turning a mucosal flap (S) over a corresponding deepithelialized area (D) (Fig. 6.51b). If mucosa is not available on the cheek flap, a mucosal flap can be taken from the side of the tongue or the remaining vermilion can be advanced to cover the defect (see Fig. 6.55).

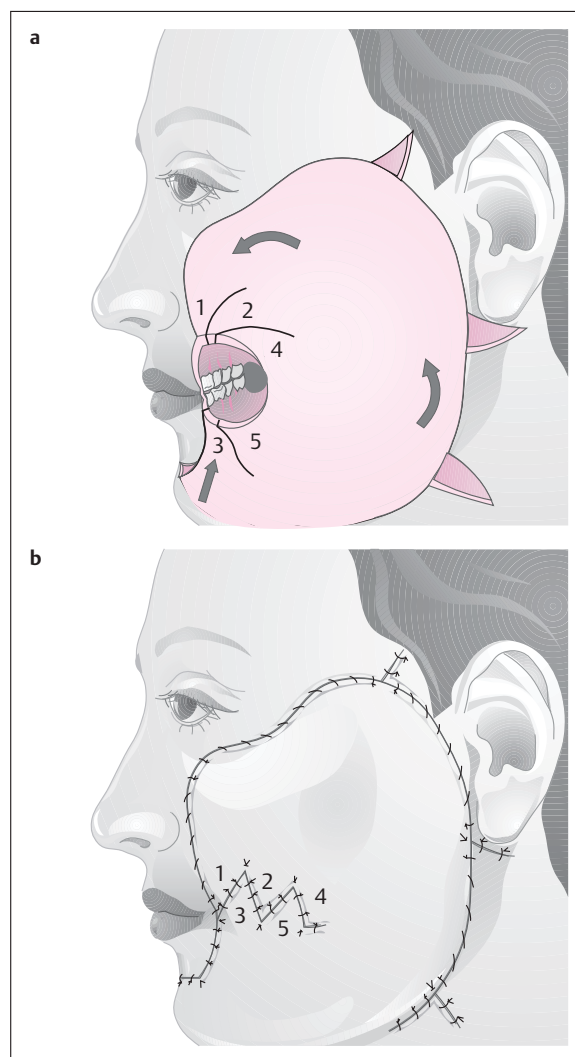


Fig. 6.52 **Large full-thickness reconstruction of the cheek and commissure** by Esser's cheek rotation combined with a tongue flap (Lexter 1909; Weerda 1985).

- a** The defect is excised and the epithelium turned inward. An Esser cheek rotation flap is outlined. An incision is made below the lower lip, and the skin is mobilized.
- b** All defects are closed, and the scars are dispersed with Z-plasties in the RSTLs. The Burow's triangles are closed. Residual defects in the oral portion of the cheek can be covered with a superiorly or posteriorly based flap of tongue mucosa. The pedicle is divided about 3 weeks later (see Fig. 6.43).

Large Full-Thickness Reconstruction of the Cheek and Commissure (Fig. 6.52)

In defects that have existed for some time, turnover flaps can be used to restore inner lining. The mucosa can also be mobilized to restore partial lining. Additionally, pedicled or free mucosal flaps from the tongue or opposite cheek as well as split-thickness skin grafts can be used for internal reconstruction after the external defect has been covered. Large ex-

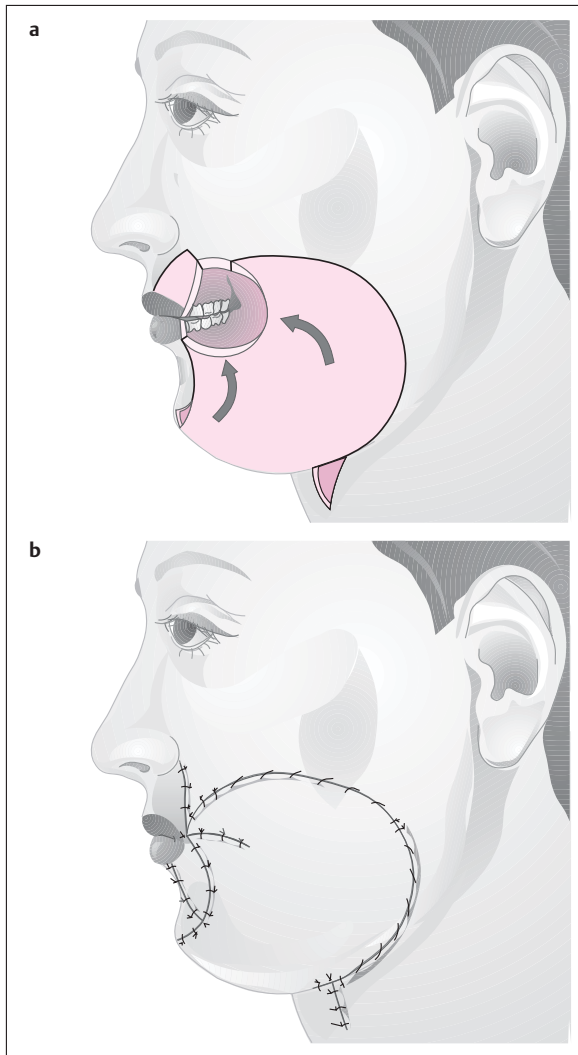


Fig. 6.53 **a Low cheek rotation** combined with an Estlander flap.
b The completed repair.

ternal defects can be covered by two-layer advancement of the overlying and underlying soft tissues. A particularly effective technique is Esser's cheek rotation (Fig. 6.52a) combined with the advancement of buccal and mental soft tissues by making an incision inferomedial to the defect and into the chin and excising Burow's triangles. An attempt should be made to place the resulting scars in the RSTLs (Fig. 6.52b). Microvascular free flaps are also an option in selected cases.

Very large defects are covered with mucocutaneous island flaps (see Figs. 12.1 and 12.2) or free grafts (see Fig. 14.1).

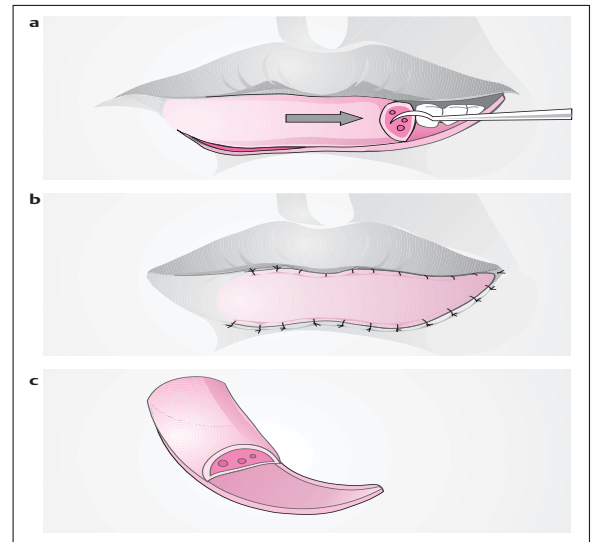


Fig. 6.54 **Vermilion advancement** of Goldstein (1984).

- a** The vermilion is incised through all three layers along the skin-vermilion border, preserving its attachment to the labial artery.
- b** The flap is advanced over the defect and sutured into place.

Asymmetric Defects of the Commissure and Cheek

(Fig. 6.53)

This type of defect can be repaired by combining an Estlander flap with a low cheek rotation that starts with all three tissue layers and then reduces to two layers (Fig. 6.53b).

Vermilion Defects

Vermilion Advancement of Goldstein (1990)

(Fig. 6.54)

The defect is closed by mobilizing the lip at the vermilion border (Fig. 6.54a, b).

Elongation of the Oral Fissure

The various Estlander lip reconstructions (see Figs. 6.24, 6.41, and 6.44) and other methods (see Fig. 6.45) cause a shortening of the oral fissure that requires secondary correction.

Method of Converse (1959) (Weerda 1983)

(Fig. 6.55)

The center of the lip is determined, and the length of vermillion is measured on the healthy side. For a bilateral elongation of the oral fissure, an average is taken. A horizontal incision is made laterally in the direction of the oral fissure, and the epithelium above and below the incision is removed (Fig. 6.55, D, right). The mucosa of the lip stump is mobilized, pulled laterally into the angle of the mouth, and secured with tie-over bolster sutures (Fig. 6.55, left).

Method of Converse (1977)

(Fig. 6.56)

After the lip length is measured, an ipsilateral triangle of skin and subcutaneous tissue is excised, exposing the oral mucosa (Fig. 6.56a, D). The medial portion of the mucosa is incised, and a smaller vertical incision is made in the commissure itself (Fig. 6.56b). The three resulting mucosal flaps (S) are turned upward, downward, and laterally and are sutured to the skin edges with 7-0 monofilament material (Fig. 6.56c, d).

Method of Ganzer (1921)

(Fig. 6.57)

If the mucosa in the angle of the mouth is sufficiently mobile, it may be possible to remove an epithelial triangle at the appropriate site and advance the entire commissure laterally (Fig. 6.57a, b).

Method of Gillies and Millard (1957)

(Fig. 6.58)

A vermillion flap is outlined on the upper or lower lip (Fig. 6.58a) according to the degree of elongation required. A two-layer excision is made at the commissure, sparing the mucosa on the inner aspect of the lower lip, which is raised as a flap (Fig. 6.58b, c). That flap is sutured to a de-epithelialized area to reconstruct the vermillion of the lower lip (Fig. 6.58d). The vermillion flap is rotated laterally to restore the upper vermillion at the commissure. The mucosal flap may have to be mobilized slightly toward the oral vestibule.

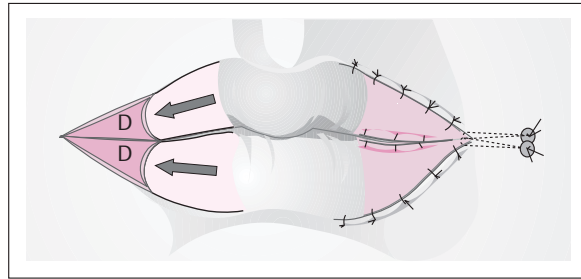


Fig. 6.55 **Elongation of the oral fissure** by the method of Converse (1959). Right side: the epithelium is excised following measurement of lip length. The vermillion is incised and mobilized (see Fig. 6.54). Left side: closure of the defects (D).

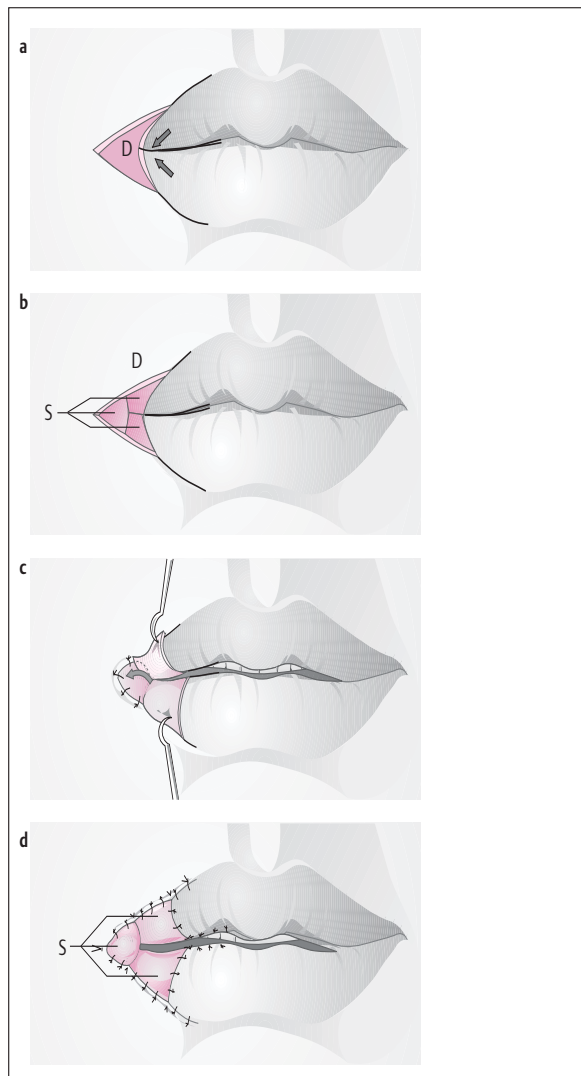


Fig. 6.56 **Elongation of the oral fissure** (Converse 1977).

- a The lip length is measured. A triangle of epithelium (D) is excised down to the mucosa, which is left intact. The existing commissure is incised (↑).
 - b T-shaped incisions are made in the exposed mucosa.
 - c The three mucosal flaps are turned.
 - d The completed repair.
- (S = mucosal flaps)

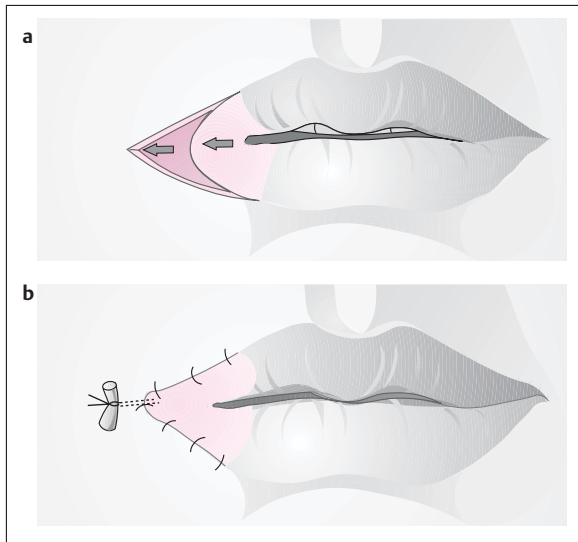


Fig. 6.57 Elongation of the oral fissure by the Ganzer method.

- a An epithelial triangle is excised following measurement of lip length. An incision is made around the vermillion without dividing it.
- b The entire vermillion is advanced laterally and sutured into the defect.

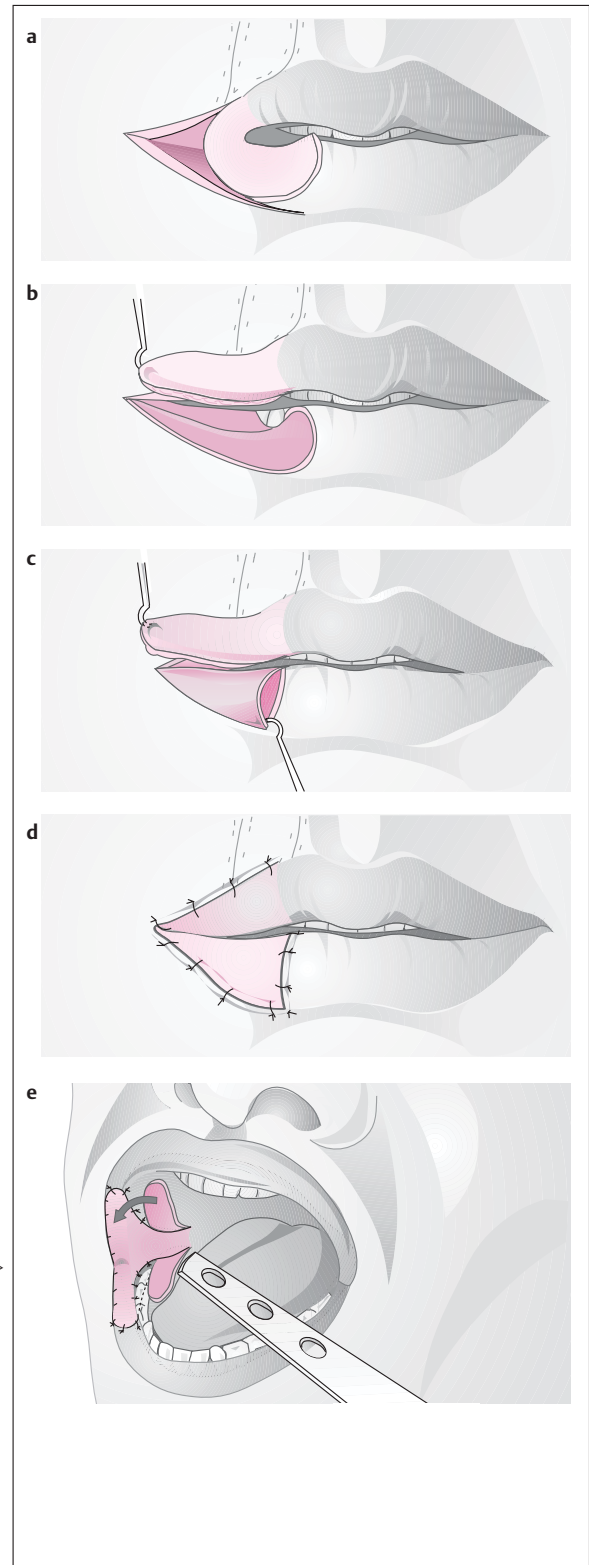


Fig. 6.58 Elongation of the oral fissure by the method of Gillies and Millard (1957).

- a After the necessary elongation is determined, a triangular segment of skin is excised lateral to the rounded commissure, and a vermillion flap is raised from the lower (or upper) lip.
- b The vermillion flap is rotated laterally, and the remaining tissue is excised down to the oral mucosa.
- c The mucosal flap is mobilized to form the vermillion of the lower lip.
- d Both flaps are sutured into the upper and lower lip defects (using 6-0 or 7-0 monofilament).
- e Two-part mucosal flap from the cheek.

7 The Chin

Coverage of Small Defects in the Chin Area

(See also Scar Revision pp. 6, 7, 8, 68, 69)

Advancement Flap

(Fig. 7.1)

Small defects in the chin area can be covered by advancement of the lateral inferior cheek (Fig. 7.1). The incision is placed below the mandibular border, and

a Burow's triangle is excised at the mandibular angle for closure of the secondary defect.

Bilobed Flap

(Fig. 7.2a, b)

A submental bilobed flap provides a very simple method for repairing this kind of defect.

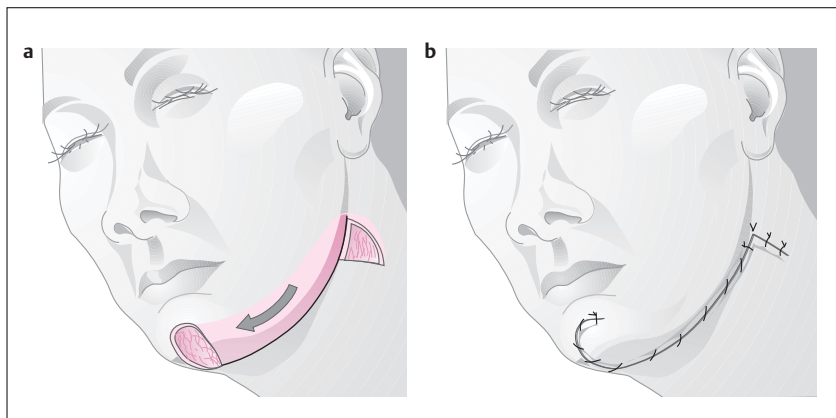


Fig. 7.1 a, b **Burow's hook-shaped cheek advancement flap**, used here to resurface a defect on the chin.

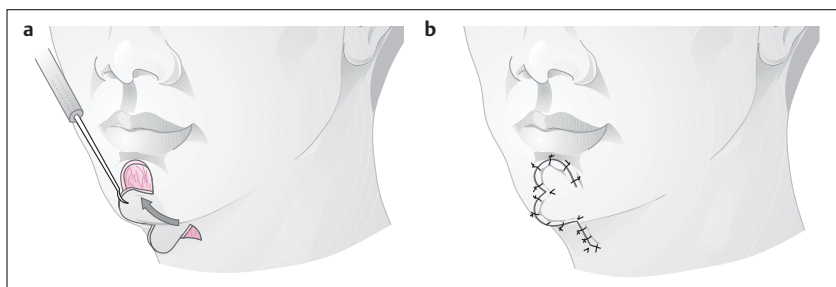


Fig. 7.2 a, b Defect repaired with a **bilobed flap**.

8 The Cheek

Medial Cheek Defects

Upper Medial Cheek

Esser Cheek Rotation (1918) (Fig. 8.1)

The Esser cheek rotation can be used to reconstruct portions of the nose as well as the medial cheek (see also Fig. 5.50a). From the defect, the incision extends along the lower eyelid and up into the temporal area, then curves down in front of the ear, where it may run a short distance back below the earlobe if necessary. It then proceeds downward and forward behind the mandibular angle (Fig. 8.1). The circumscribed flap is mobilized in the fat plane and rotated forward. Ectropion is prevented by fixing the flap to the periosteum of the infraorbital region. Burow's triangles are excised to close the secondary defect. If greater rotation is needed, the submandibular limb of the incision can be extended. The surgeon should not dissect too deeply in the fat, especially in the temporal area, as this could damage intact facial nerve branches.

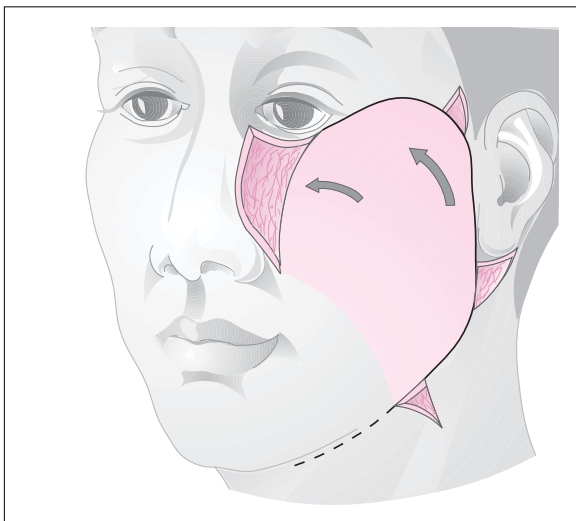


Fig. 8.1 **Esser cheek rotation** (1918). The flap is cut somewhat higher in the temporal area to provide excess tissue at the lower lid (to prevent ectropion). It is fixed to the periosteum of the orbital rim, and the cheek skin is mobilized (sparing the branches of the facial nerve).

Cheek Reconstruction Combining the Methods of Esser (1918) and Imre (1928) (Weerda 1980) (Fig. 8.2)

For defects of the medial cheek and lower eyelid area, it may be necessary to combine the Esser flap with a nasolabial advancement. We have obtained good overall cheek mobility by combining the Esser rotation with a two-layer crescent-shaped excision in the nasolabial fold.

Small Cheek Defects

Small defects are repaired with transposition or rotation flaps, and small bilobed flaps can also be used (see pp. 6, 13–17, 22; Figs. 3.1b and 3.22). Defects in the nasal flank area can be closed by a Burow-type cheek advancement with a Burow's triangle (Fig. 8.3) or by excising a skin crescent in the nasolabial angle (see Fig. 8.4).

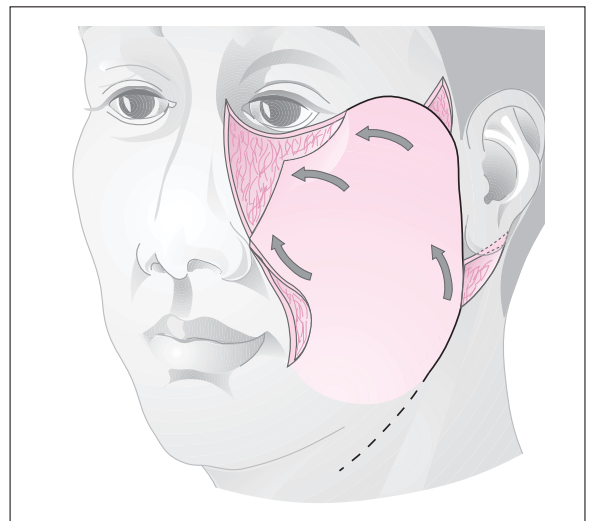


Fig. 8.2 **Cheek reconstruction** combining the Esser and Imre techniques (Weerda 1980). A crescent-shaped excision in the nasolabial fold is added to the Esser rotation (see Fig. 8.1). The flap is mobilized in the fat plane to avoid facial nerve injury (see Fig. 9.10).

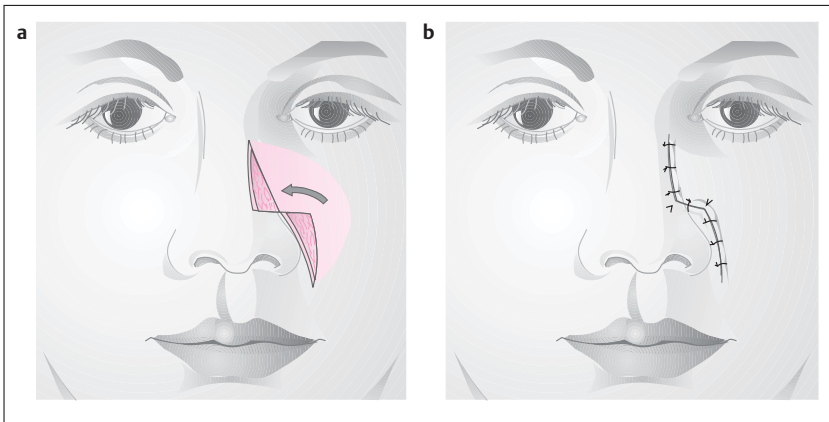


Fig. 8.3

- a** Burow's cheek advancement.
b The scars are located in the nasal flank and nasolabial fold (see Fig. 5.22).

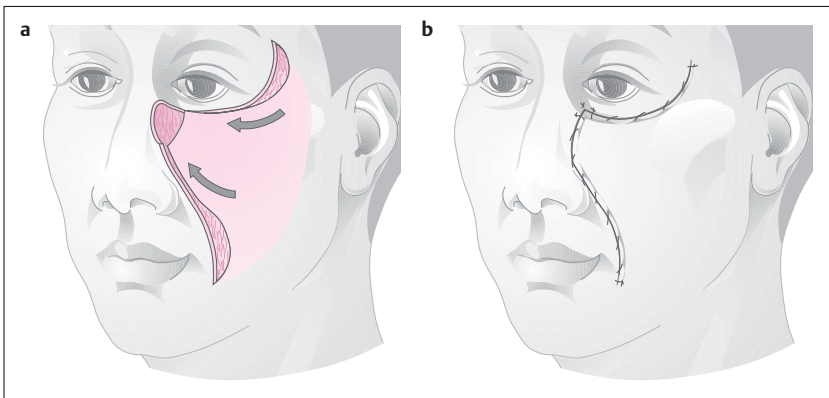


Fig. 8.4

- a** Modified Imre cheek advancement.
b The scars are located at the boundaries of the esthetic units and in the RSTLs (nasolabial fold) (see Fig. 9.10).

Imre Cheek Advancement Flap (After Haas 1973, Modified) (Figs. 8.4 and 8.5)

Modified Esser Cheek Rotation For Nasal Flank Defects (Fig. 8.6)

This rotation flap is developed somewhat higher into the temporal area, and a cut is made around the earlobe, where a second Burow's triangle is placed. If the flap is not sufficiently mobile, the incision can be extended (see p. 84 and Fig. 8.1).

Defect in the Medial Canthus (Fig. 8.7)

A medial defect can be repaired with an Imre cheek rotation flap combined with a rotation flap from the forehead (see Figs. 5.2–5.8).

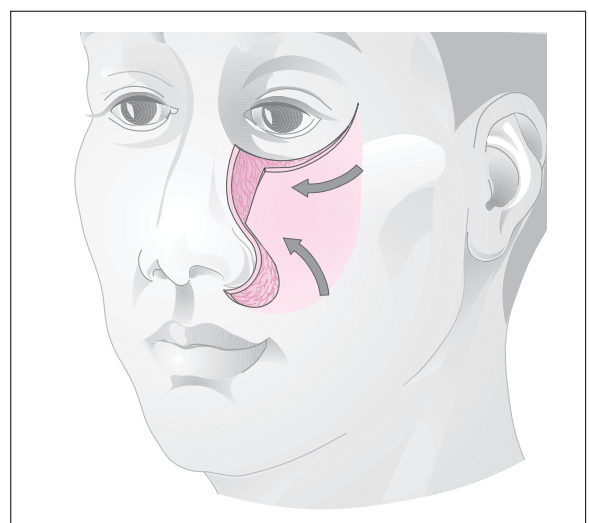


Fig. 8.5 **Modified Imre flap**. The scar is located in the alar groove.

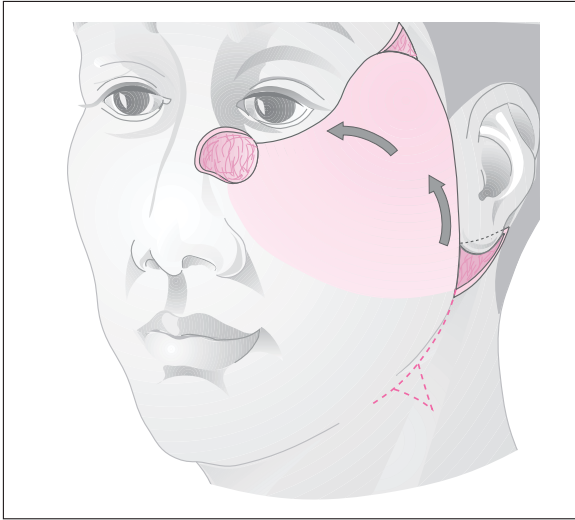


Fig. 8.6 **Modified Esser cheek rotation** (see Fig. 8.1). It may be necessary to extend the flap incision around the mandibular angle. Burow's triangles are excised for counter-rotation and to reduce the size of the secondary defects.

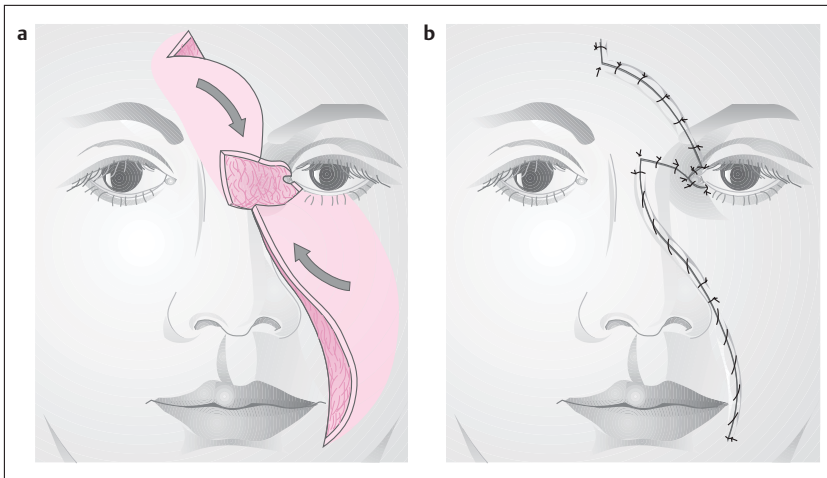


Fig. 8.7 **a, b** Imre cheek rotation combined with a small forehead flap to repair a defect involving the cheek and medial canthal area (see Figs. 5.2–5.8; see also Fig. 8.2).

Mid-Anterior Cheek

(Fig. 8.8)

Pedicle Bilobed Flaps

Inferiorly based bilobed flaps are particularly suitable for elderly patients (Dean et al. 1975; Weerda

1983). The secondary lobe may be placed behind the ear or in the upper neck (Fig. 8.8a, b).

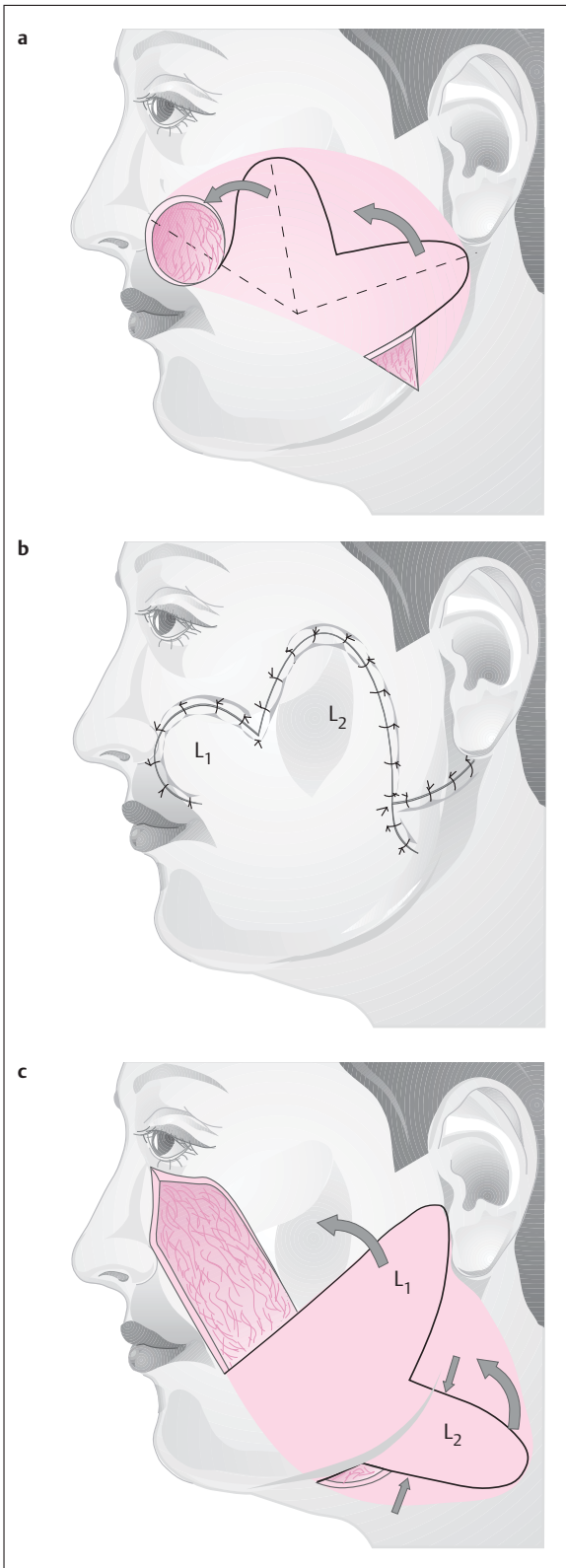


Fig. 8.8 **a, b** Inferiorly based bilobed flap.
c Modified bilobed flap for larger defects.

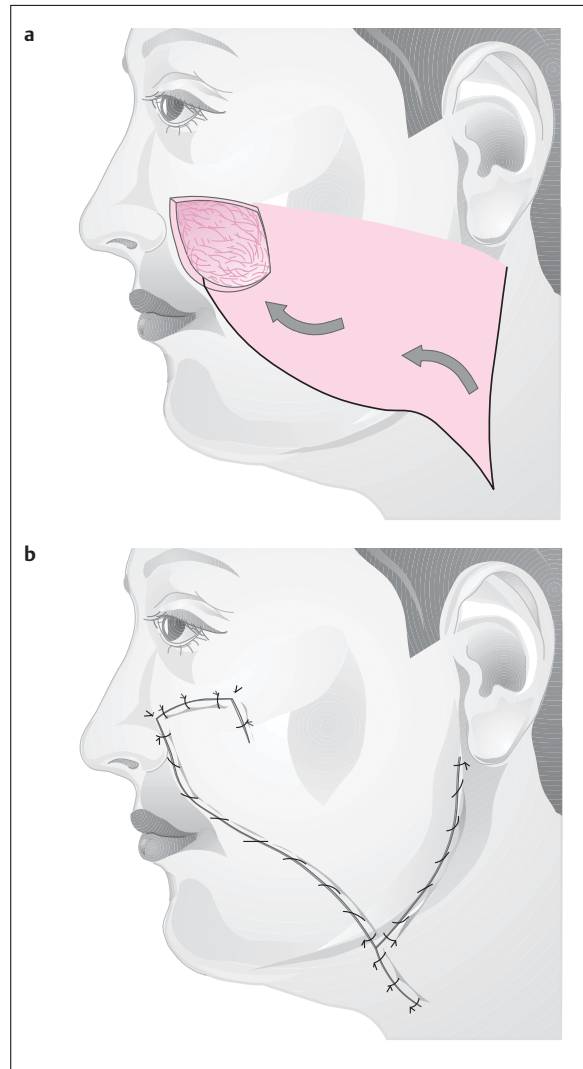


Fig. 8.9 **a, b** V-Y advancement of the cheek.

V-Y Advancement

(Fig. 8.9)

Upper and Posterior Cheek

Trilobed Flap of Weerda (1979)

(Fig. 8.10)

Occasionally a bilobed flap is insufficient for repairing a cheek defect, which requires one lobe between the ear and defect (Fig. 8.10a), a second lobe behind the ear, and a third lobe in the lateral neck.

As in an Esser cheek rotation, the lower limb of the third lobe may be extended below the mandible. Closure of the secondary defects may require the excision of Burow's triangles (Fig. 8.10b).

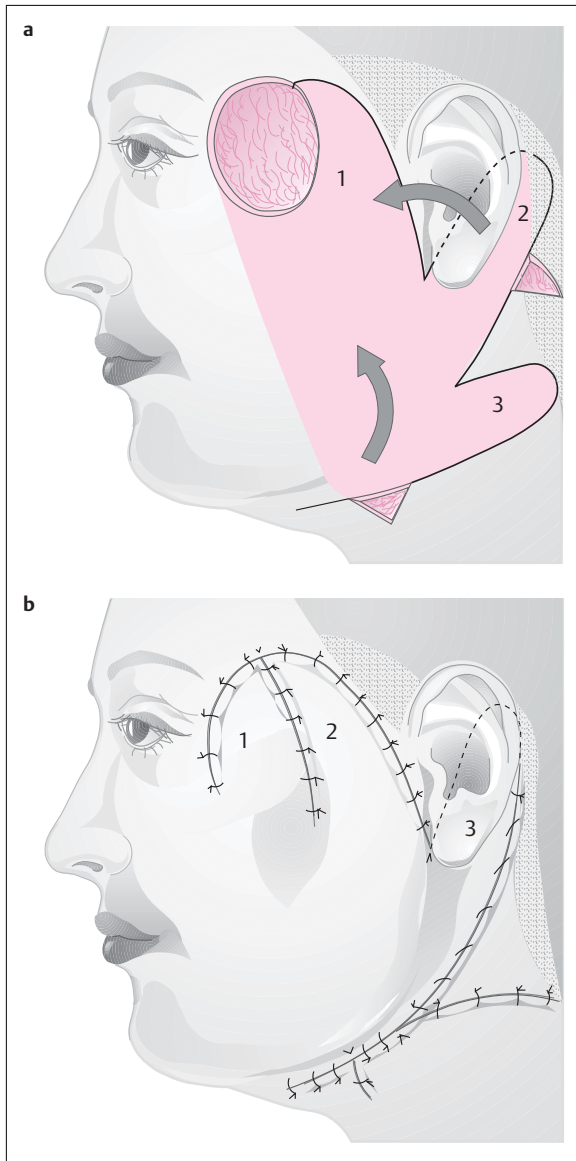


Fig. 8.10 **Trilobed flap** of Weerda (1979).

- a** Trilobed flap for a defect in the temporal region consists of a preauricular lobe (1), a retroauricular lobe (2), and a neck lobe (3).
- b** The completed repair. All defects can be closed by excising Burow's triangles and mobilizing the surrounding skin.

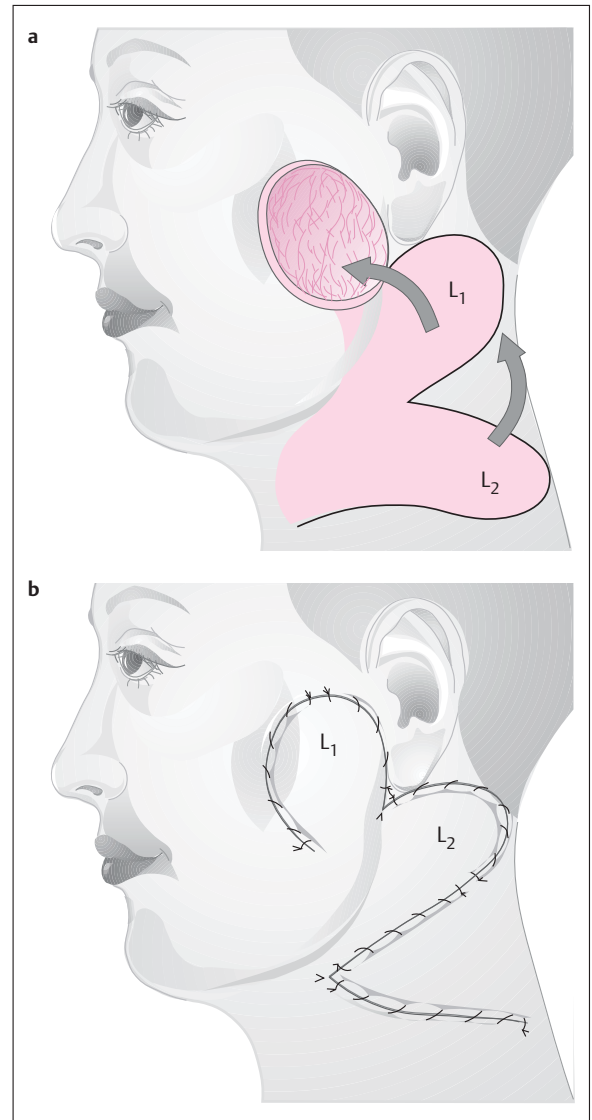


Fig. 8.11 **a, b** Bilobed flap from the side of the neck.

Bilobed Flap

(Fig. 8.11)

A defect involving the lateral cheek or earlobe area can be repaired with a retroauricular bilobed flap (Fig. 8.11a). The somewhat smaller secondary lobe is raised from the side of the neck (Fig. 8.11b).

Lateral Cheek Defects

Small Lateral Cheek Defects

These defects can be repaired with various flaps, such as transposition flaps (Fig. 8.12), the trapezoidal flaps described by Limberg or Dufourmentel (Fig. 8.13; see Figs. 3.24–3.27), by flap advancement, or by Z-plasties (Figs. 8.14 and 8.15).

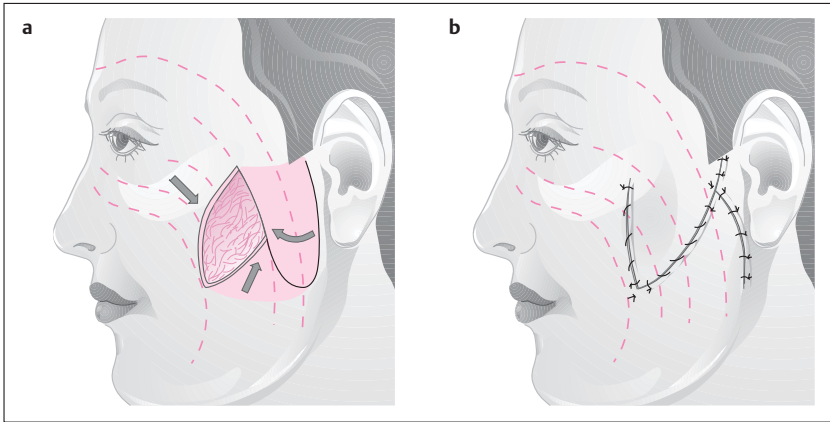


Fig. 8.12 **a, b** Small **preauricular transposition flap** (can be cut slightly smaller than the defect). Scar revision may be necessary as a secondary procedure.

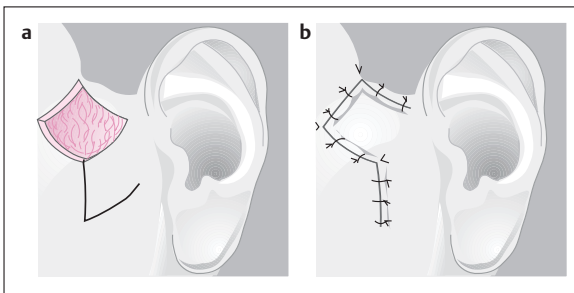


Fig. 8.13 **a, b** Limberg flap (rhomboid flap; see Figs. 3.24–3.27).

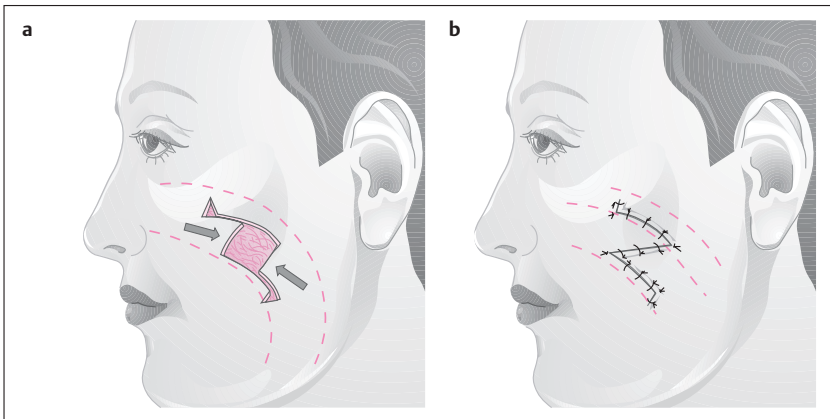


Fig. 8.14 **a, b** Double advancement flap (see Fig. 3.1).

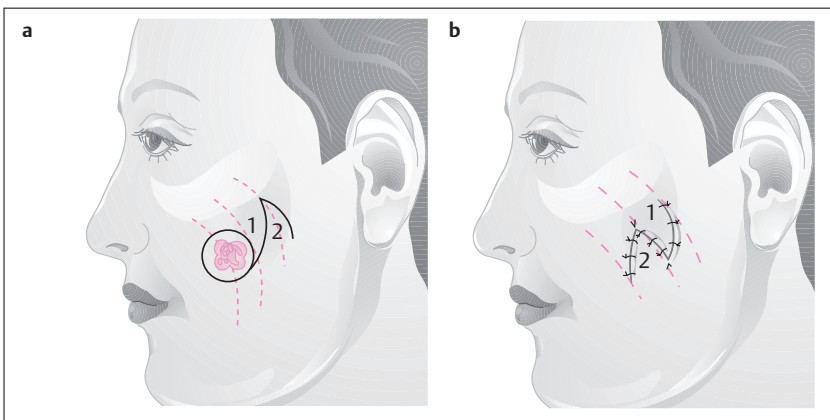


Fig. 8.15 **a, b** Small cheek defect repaired by a **Z-plasty** (see Figs. 2.15 and 4.1).

Small Preauricular Defects

Small preauricular defects can be covered by advancing tissue from the retroauricular neck area (Fig. 8.16).

Simple Skin Advancement and Rotation (Burow's Method)

(Fig. 8.17a–d)

Wedge-shaped defects of the lower lateral cheek can be repaired by a simple Burow skin advancement (Fig. 8.17a, b). For a round or oval defect, we use rotation flaps from the upper neck (Fig. 8.17c, d).

Opposing Transposition Flaps

(Fig. 8.18)

If the primary reconstruction flap can be raised in the preauricular area (Fig. 8.18a), the secondary defect can be closed with an inferiorly based retroauricular flap. The tertiary defect can then be covered by mobilization (Fig. 8.18) or with a thick split skin graft (e.g., from the buttock).

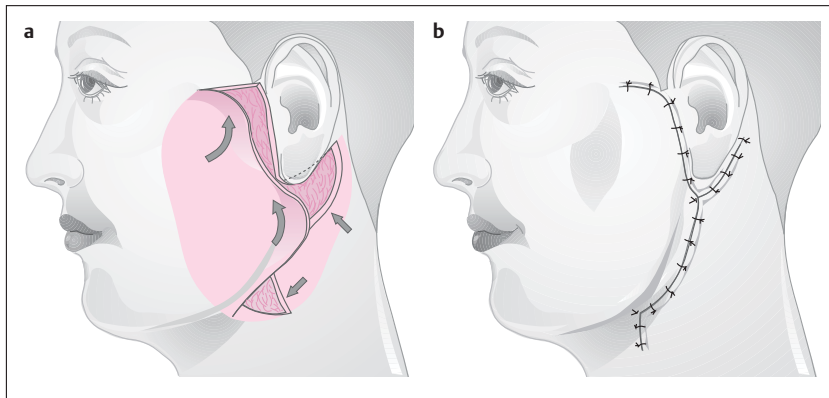


Fig. 8.16a, b Skin advancement from the retroauricular area.

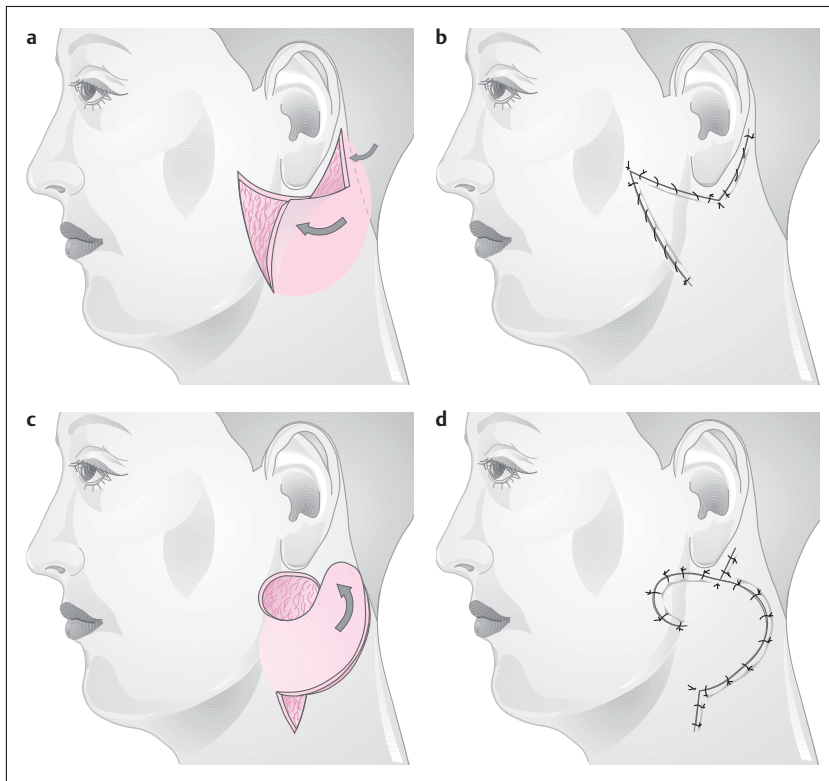


Fig. 8.17 Burow's flap advancement.

- a Wedge-shaped defect with a superior base. A retroauricular Burow's triangle is excised.
- b The completed repair.
- c A circular defect is covered with a rotation flap from the upper neck.
- d The completed repair.

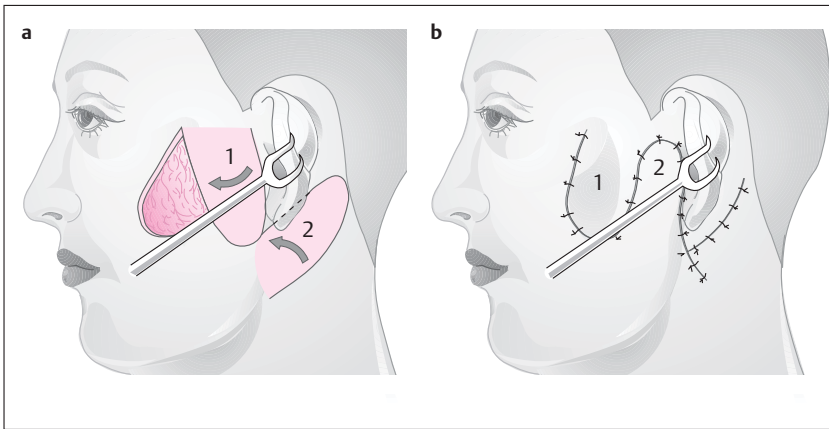


Fig. 8.18

- a** Cheek defect is repaired with a preauricular transposition flap (1). A second, inferiorly based flap is also raised (2).
b The completed repair.

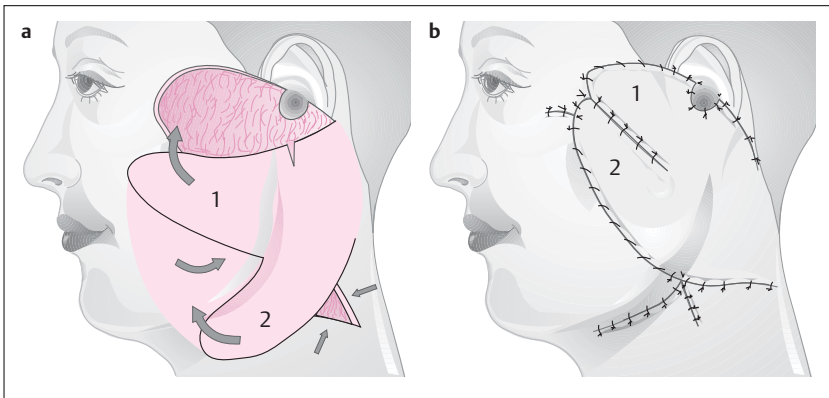


Fig. 8.19 Posteriorly based bilobed flap from the cheek and submandibular region (Weerda 1978 b, 1980 c).

- a** Large defect involving the posterior upper cheek and the auricle. (1) One lobe of the flap is outlined below the defect. (2) A second lobe is outlined in the submandibular area. Burow's triangles are excised to close the secondary defects.
b The completed repair.

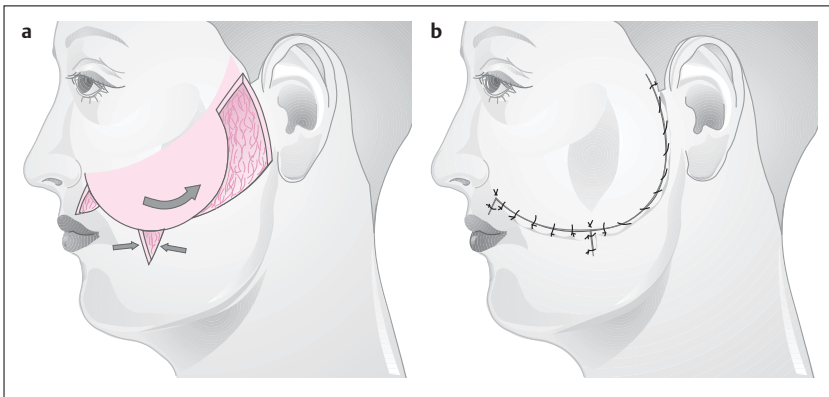


Fig. 8.20 Lateral cheek rotation of Weerda (1980 c).

Large Defects Involving the Auricle

A large defect involving the auricle can be repaired by transposing a posterosuperiorly based bilobed flap with a submandibular secondary lobe (Fig. 8.19).

Lateral Cheek Rotation of Weerda (1980c)

(Figs. 8.20 and 8.21)

Moderate-sized preauricular cheek defects can be repaired with a superiorly based cheek rotation flap (Fig. 8.20). A transposition flap with V-Y advancement can be used in the inferolateral cheek area (Fig. 8.21).

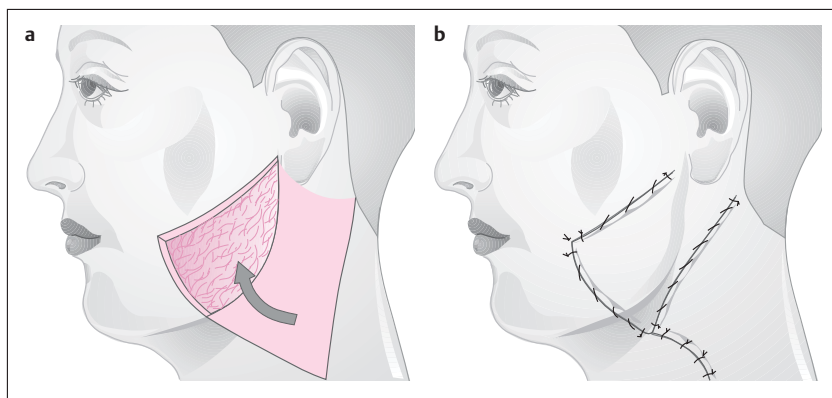


Fig. 8.21 Low lateral cheek defect repaired with a transposition flap from the neck.

- a** The superiorly based transposition flap is outlined in a rhomboid-like design.
- b** All defects are closed by V-Y advancement.

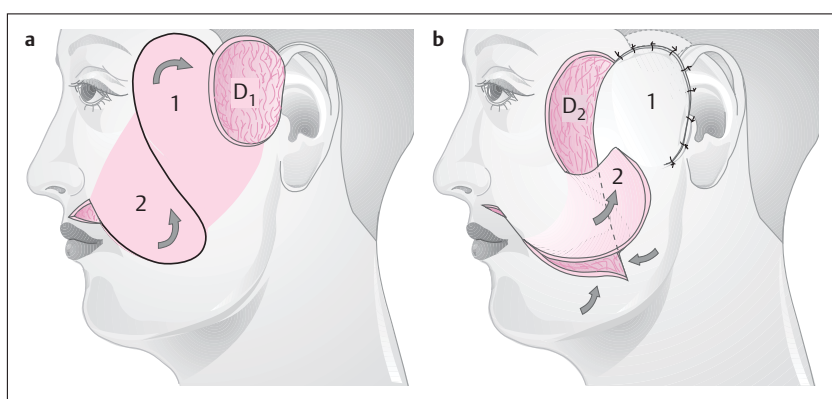


Fig. 8.22 Defect in the upper preauricular region (D1).

- a** Inferiorly based transposition flap (1).
- b** The secondary defect (D2) is closed by lateral cheek rotation (2).

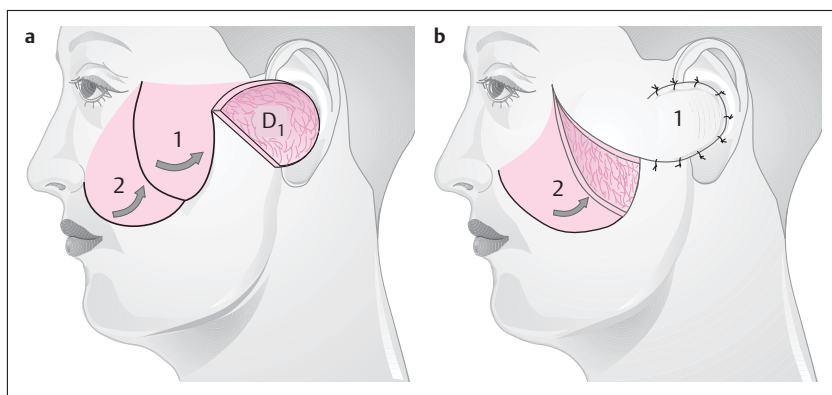


Fig. 8.23 Defect involving the ear (D1).

- a** Superiorly based preauricular flap (1).
- b** The secondary defect is closed by lateral cheek rotation (2).

Pediced Transposition Flaps

(Figs. 8.22 and 8.23)

Defects of the concha and preauricular region may sometimes require a flap that does not follow the RSTLs, especially in the case of elderly patients where swift treatment and rehabilitation are a prior-

ity. We have repaired these cases with an inferiorly based (Fig. 8.22) or temporally based transposition flap (Fig. 8.23 1), using an anteriorly based cheek rotation to close the secondary defect (Figs. 8.22 and 8.23, 2).

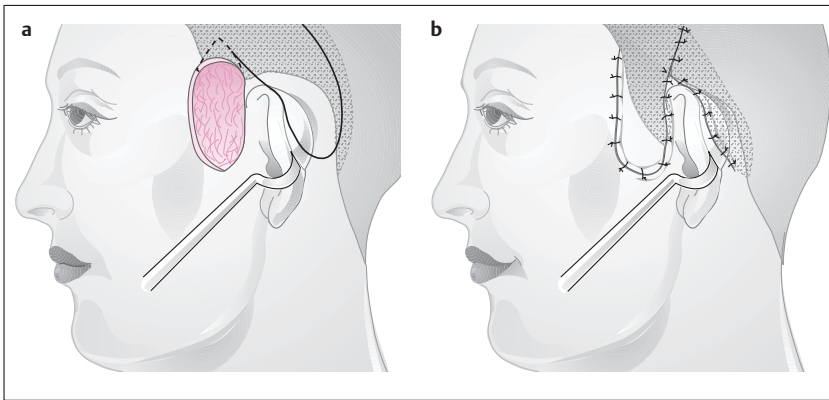


Fig. 8.24 Preauricular hair loss corrected with a superiorly based **retroauricular transposition flap**.

- a** Outline of the transposition flap, which is hair-bearing in its lateral portion.
- b** The completed repair.

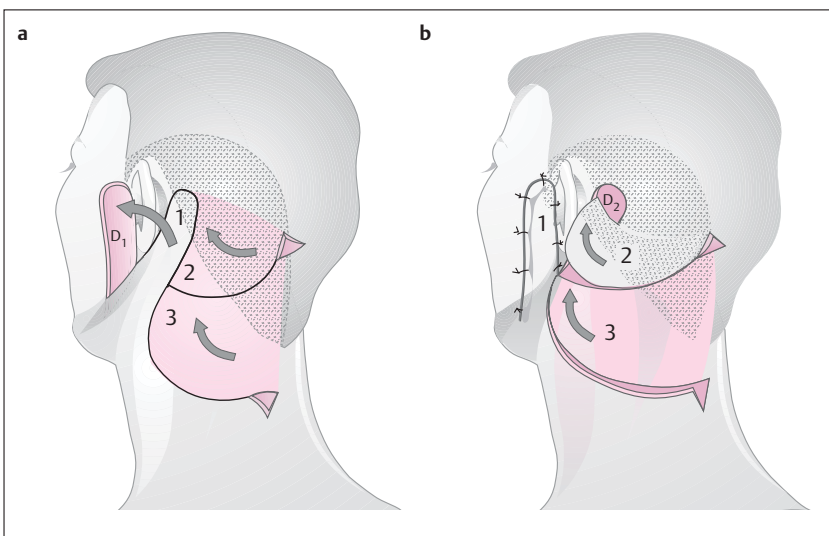


Fig. 8.25 **a, b** Use of **multiple flaps** to close a large defect of the **lateral cheek** (D1). Inferiorly based transposition flap (1) from the side of the neck is combined with rotation flaps (2, 3) to close the defects.

Preauricular Hair Loss

(Fig. 8.24)

Preauricular defects can be covered with restoration of hair by transposing a superiorly based retroauricular flap whose upper portion is hair-bearing. The lower portion of the flap is designed to transfer hairless skin to the cheek. The specific flap design will depend on whether the patient is male or female (see Fig. 8.18).

Inferiorly Based Retroauricular Transposition flap (Weerda 1978a)

(Fig. 8.25)

A large defect involving the auricle and preauricular region can be covered with a large inferiorly based retroauricular flap. The secondary defect is closed by rotating the surrounding skin. Hair can be transferred with the flap if desired.

Large Bilobed Flap from the Neck (Weerda 1980b)

(Fig. 8.26)

We cover large defects of the lower lateral cheek and neck with a posteriorly based bilobed flap from the submandibular or neck-shoulder region. With exten-

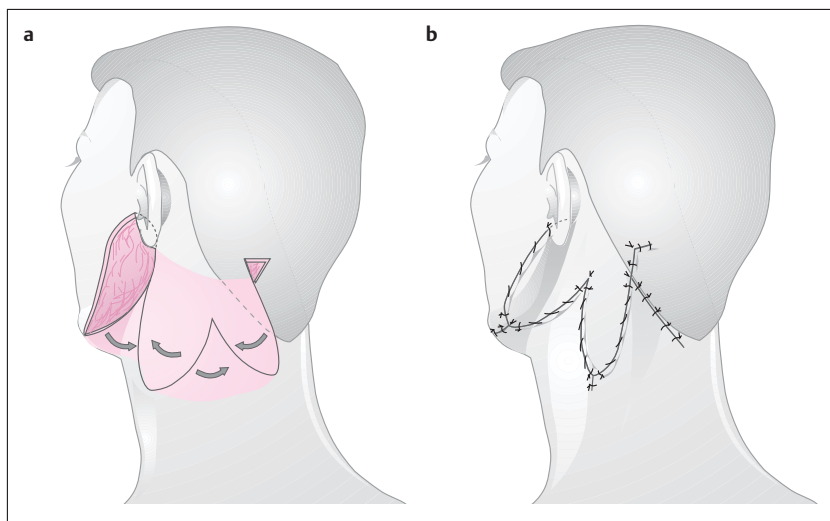


Fig. 8.26 Use of a posterosuperiorly based **bilobed flap** to close a defect in the lower cheek.

a Outline of the superiorly based bilobed flap.

b The completed repair.

sive defects, the flap should be delayed. We prefer a myocutaneous flap in older patients, i.e., a mucocutaneous pectoralis major island flap or latissimus

dorsi flap. If a skilled team is available, a radial forearm flap can be transferred to the recipient site by microvascular anastomosis (see Fig. 14.1).

9 The Eyelids

Upper Eyelid

Direct Closure

(Fig. 9.1)

Direct closure is suitable for defects that involve up to one-fourth (approximately 8 mm) of the eyelid margin (semicircular flap closure, Fig. 9.1).

Semicircular Flap Closure of Beyer-Machule et al. (1993)

(Fig. 9.2)

Larger defects involving up to one-half of the lid margin can be closed by advancing a semicircular skin flap medially (Fig. 9.2a). The lid margin is sutured first (see also Fig. 9.1). Next the tarsus and orbicularis

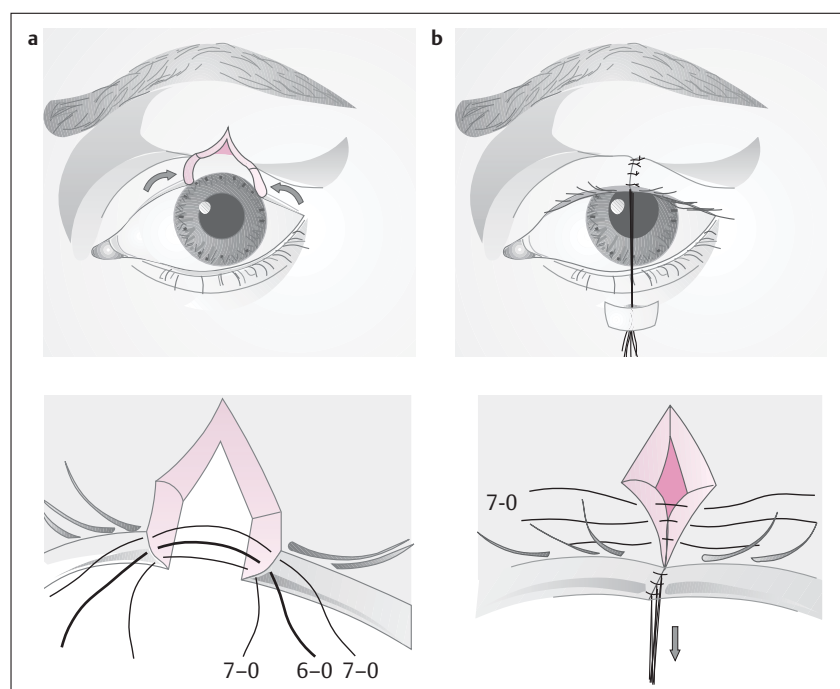


Fig. 9.1 Direct primary closure of an **upper eyelid defect** involving up to one-fourth the length of the lid margin (approximately 8 mm).

a The lid margin is closed with 6-0 or 7-0 PDS sutures. The tarsus and orbicularis muscle are then approximated with interrupted 6-0 absorbable sutures.

b Continuous 7-0 monofilament suture. The ends of the adjacent deep intermarginal sutures are tied on the anterior lid margin to prevent them scratching the eye. Traction sutures are left long and taped to the cheek.

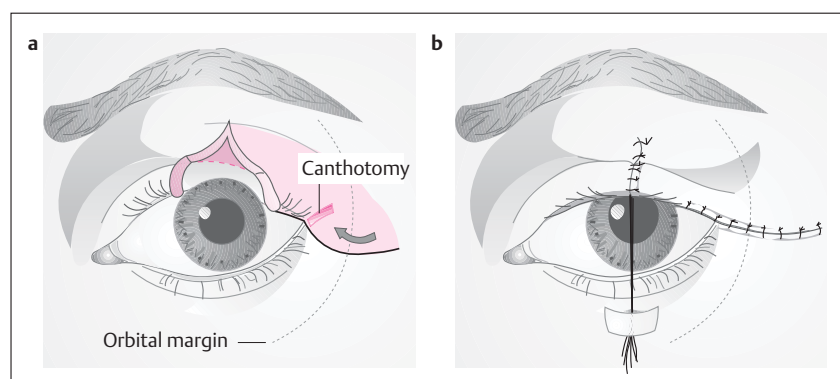


Fig. 9.2 **Lateral semicircular flap closure of an upper eyelid defect** involving one-fourth to one-half the length of the lid.

a A lateral canthotomy of the upper palpebral ligament is performed to facilitate advancement of the lateral skin.

b All the wounds are closed (see Fig. 9.1). The same technique is used in the lower lid.

muscle are approximated with 6–0 interrupted Vicryl sutures Ethicon, Hamburg-Norderstedt, Germany, and the skin is closed with 7–0 interrupted monofilament sutures (see Fig. 9.1a, b). The lid margin is approximated with three stay sutures, two of which are placed deeply (close to the eyeball) and one more superficially (Beyer-Machule and Riedel 1993). Large upper lid defects are rare and should be repaired only by surgeons experienced in eyelid surgery.

Switch Flap

(Fig. 9.3)

Analogous to the Abbe lip switch, this flap can be rotated from the lower eyelid into a full-thickness

upper eyelid defect involving up to one-fourth the length of the lid margin (Fig. 9.3a, b). The eye itself is covered with a special protector to prevent corneal injury. The lower lid defect is closed directly with continuous 6–0 monofilament (Fig. 9.3b), followed by the placement of both upper lid sutures (Fig. 9.3c).

Upper Eyelid Reconstruction of Fricke and Kreibitz

(Fig. 9.4)

Large portions of the upper (and lower) eyelid can be reconstructed with a narrow transposition flap that is raised above the eyebrow on a lateral pedicle. Thick split retroauricular skin grafts can also be used.

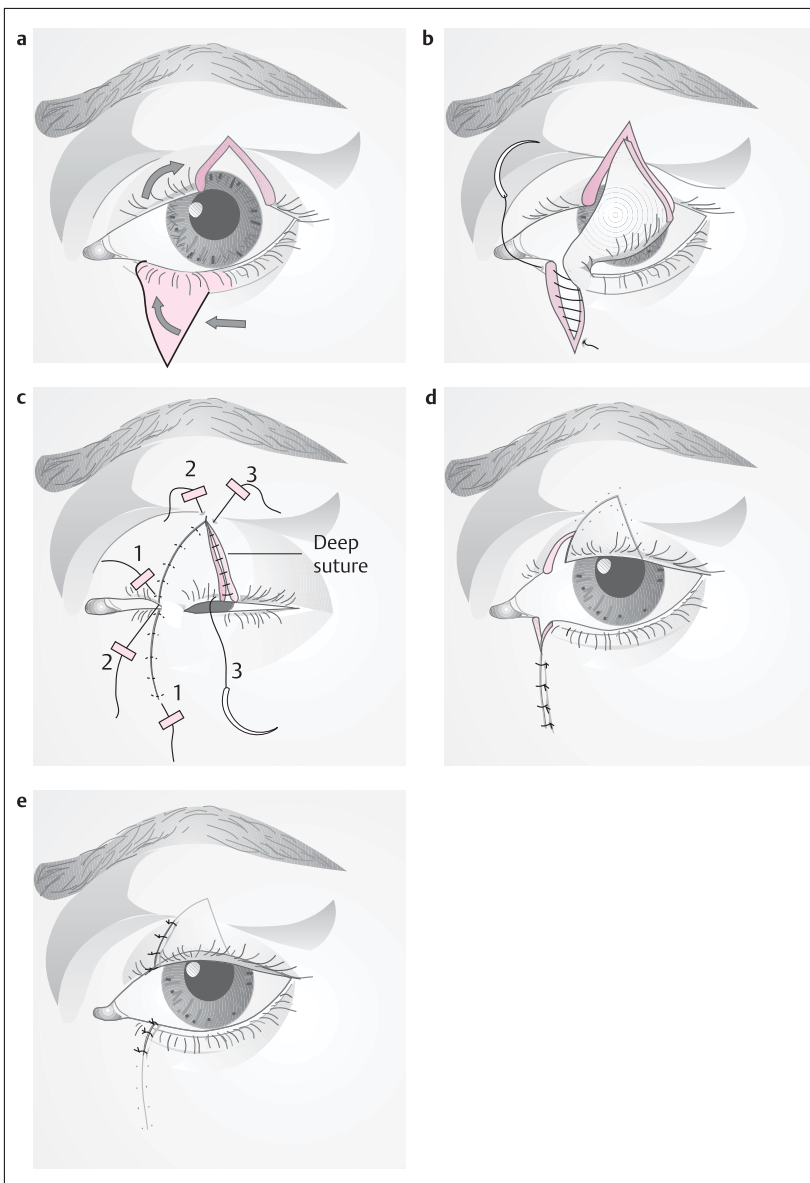


Fig. 9.3 Mustarde's technique of upper eyelid reconstruction using a laterally based full-thickness flap from the lower lid (after Beyer-Machule and Riedel 1993).

- a The full-thickness lower lid flap is outlined with a lateral pedicle.
- b The flap is swung into the upper lid defect, and the lower lid defect is closed.
- c Continuous suture line incorporates three interrupted sutures that close the defect and are taped to the skin.
- d, e About 3 weeks later, the pedicle is divided and the defects are closed.

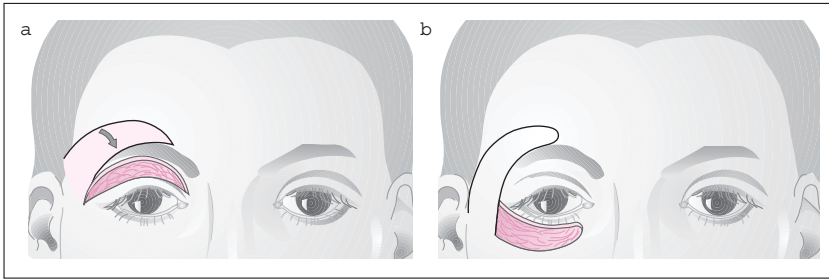


Fig. 9.4 **Transposition flap** from the forehead described by Fricke and Kreibitz for reconstruction of the upper eyelid (a) and lower eyelid (b).

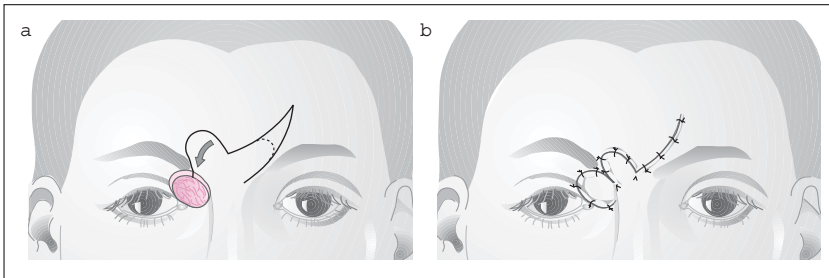


Fig. 9.5 **a, b** Closure of **medial upper lid defects** with a bilobed flap (see Figs. 5.3–5.7 and 5.24).

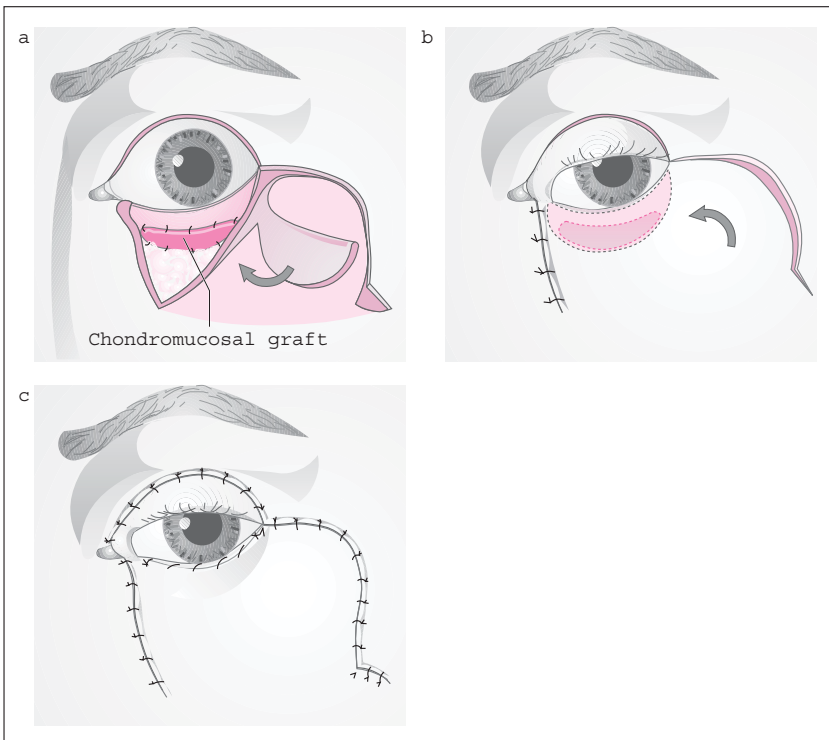


Fig. 9.6 **Total upper lid reconstruction** by Mustarde's two-step technique.

- a** Laterally based semicircular lower lid flap is used to reconstruct the upper lid (see Fig. 9.2). A chondromucosal composite graft is taken from the septum. The mucosal part of the graft is twice as large as the cartilaginous part.
- b** The composite graft is used to replace the lower lid.
- c** All defects are closed. Three weeks later the pedicle is divided and inset (see Fig. 9.3 **d, e**) (after Beyer-Machule and Riedel 1993).

Bilobed Flap (Fig. 9.5)

More medially situated defects of the upper eyelid can be repaired with a bilobed flap from the forehead. The secondary lobe should be slightly larger than the primary lobe. Rotation of the secondary lobe may cause skin bunching that requires correction in a second operation (Fig. 9.5**b**). A V-Y advancement can also be used (see Figs. 5.2–5.7).

Total Upper Lid Reconstruction by the Two-Stage Mustarde Technique (Beyer-Machule and Riedel 1993) (Fig. 9.6)

Similar to the switch flap (see Fig. 9.3), the entire lower lid is raised on a lateral pedicle (Fig. 9.6**a**). The semicircular flap is transposed medially and rotated upward into the upper lid (Fig. 9.6**b**). The lower lid is reconstructed with a composite graft from the sep-

tum (see Fig. 9.7). The pedicle is divided about 3 weeks later (see Fig. 9.3d, e).

Reconstruction of the Lower Eyelid

Reconstruction of Small Defects in the Lower Eyelid

Small defects of the lower eyelid can sometimes be closed by direct suture (see Fig. 9.1b) or, as in the upper lid, by transposing a flap from the upper lid (see Fig. 9.3), analogous to the Abbe switch flap.

Large Defects

(Fig. 9.7; see also Fig. 9.6)

As in the upper lid, the rotation-advancement technique of Mustarde (1980) can be used to close a large defect in the lower lid. The incision starts in the lateral canthus, curves upward, and ends in the preauricular area. The skin is undermined in a fairly shallow plane, and the lid defect is incorporated into a wedge excision that points downward (Fig. 9.7a). A chondromucosal composite graft from the septum is used for inner lining. The cartilaginous part of the graft should be slightly smaller than the mucosal part. The septal cartilage is thinned to 1–1.5 mm using a No. 11 scalpel blade or special cartilage knife. After the composite graft has been sewn into place (with the mucosa inward), the defect is closed by ro-

tation-advancement of the lateral cheek skin (Fig. 9.7b). Special care is taken to reconstruct the lacrimal ducts (Fig. 9.7c).

Reconstruction of the Lower Lid with Ectropion

Transposition Flap

(Figs. 9.8 and 9.9)

A superiorly based lateral transposition flap (as described by von Langenbeck) is excellent for reconstructing a lower eyelid defect and also correcting ectropion due to scarring (Fig. 9.8). Larger flaps can be obtained medially (Fig. 9.9). A retroauricular full-thickness skin graft or an Imre cheek rotation flap are also good options for this type of reconstruction (Fig. 9.10; see also Figs. 8.2 and 8.7).

A few cases will also require use of a cartilage graft or chondromucosal composite graft from the nasal septum (see Fig. 9.6).

Total Lower Lid Reconstruction

(Figs. 9.11 and 9.12)

The entire lower lid can be reconstructed with a transposition flap (Fig. 9.11a, b) or a bipedicle flap (myocutaneous flap, Fig. 9.12a, b) from the upper eyelid (Tripiet flap). As in other methods, a chondromucosal graft from the nasal septum can be used for lining (see Figs. 9.6 and 9.7). The lateral and medial pedicles are divided and inset in a later sitting.

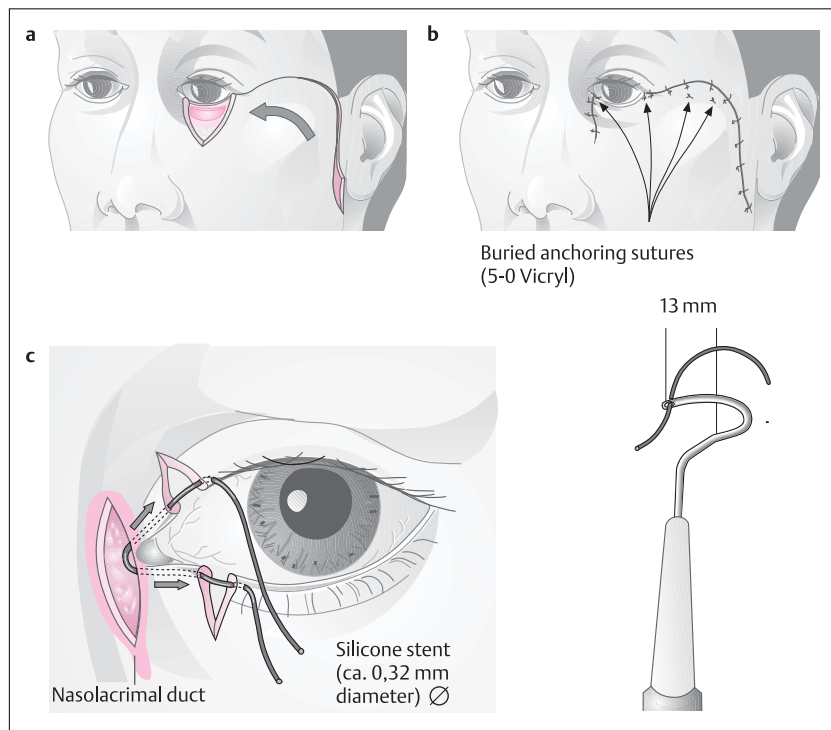


Fig. 9.7 Lower lid reconstruction using the rotation-advancement technique of Mustarde (1980).

- a The mucosal defect is reconstructed with a composite graft from the septum. Note the curved flap incision in the temporal region (see Fig. 9.6; see also Figs. 8.1 and 8.6).
- b The reconstruction is completed.
- c The lacrimal ducts are intubated with a pigtail catheter and splinted with a small silicone stent.

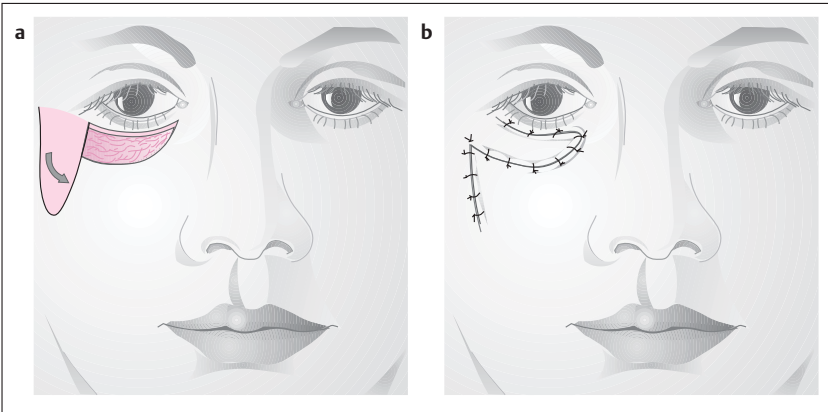


Fig. 9.8 a, b Transposition flap of von Langenbeck for repairing a lower lid defect and correcting ectropion.

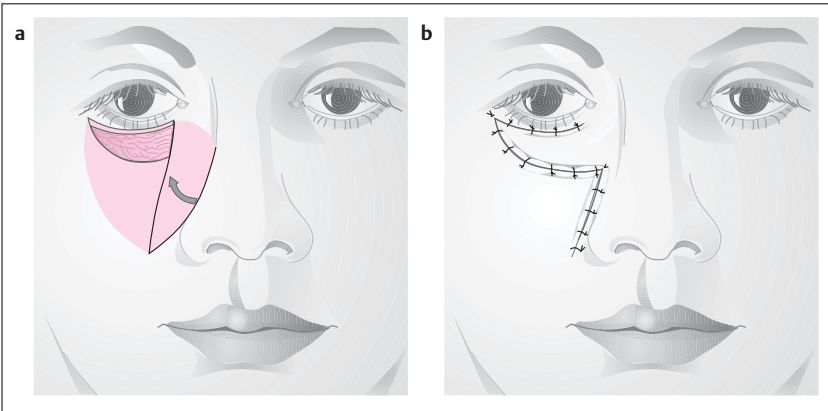


Fig. 9.9 a, b Median nasolabial flap for repairing a lower lid defect or correcting ectropion.

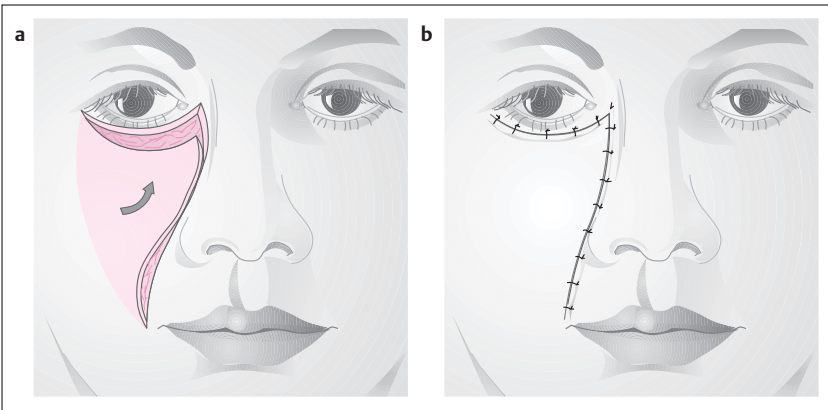


Fig. 9.10 Imre cheek advancement for repairing a lower lid defect or correcting ectropion (see Fig. 8.2).

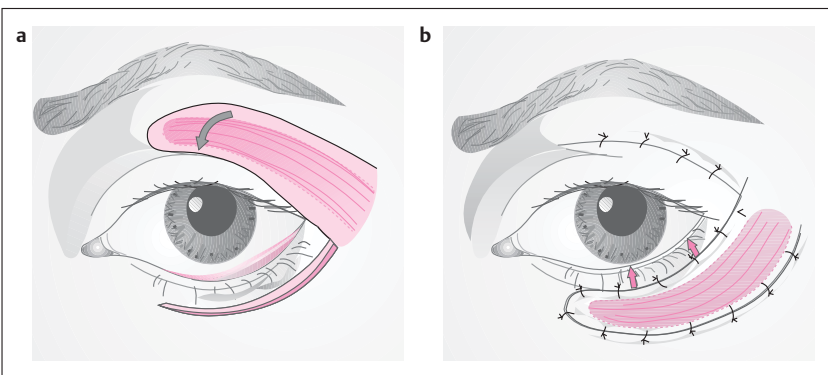


Fig. 9.11 a, b Simple mucocutaneous transposition flap (Tripier flap) from the upper lid is used to correct ectropion of the lower lid.

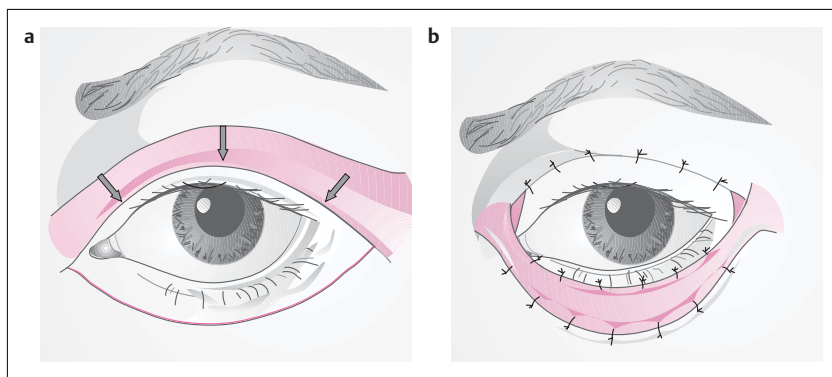


Fig. 9.12 **Double Tripiier flap** designed as a bipedicle flap.

- a** The flap is outlined in the upper eyelid as a myocutaneous flap.
- b** The flap is transposed, eliminating ectropion of the lower eyelid. About 3 weeks later the lateral and medial pedicles are divided and inset (see Fig. 9.3d, e).

Reconstruction of the Medial Canthus

(Figs. 9.13 and 9.14) (see also Figs. 5.2–5.7)

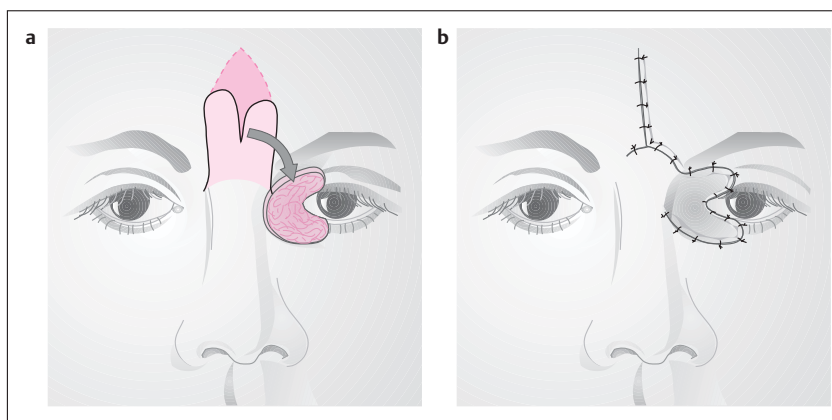


Fig. 9.13 **a, b Medial canthal defect** repaired with a **bilobed forehead flap** (see Figs. 5.3–5.7 and 9.5).

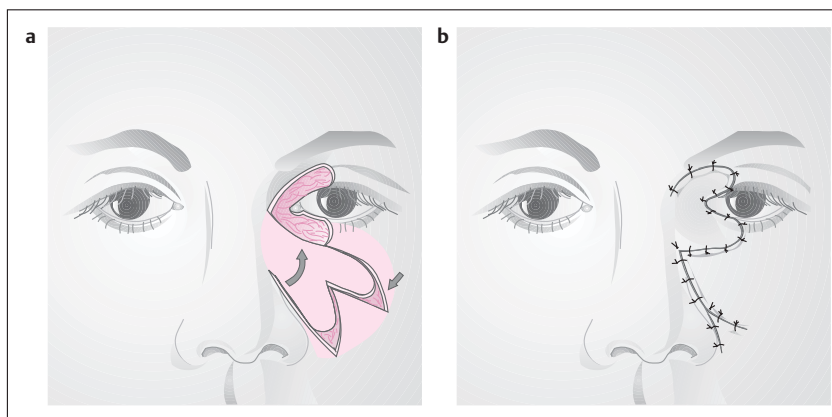


Fig. 9.14 **a, b Use of a bilobed cheek flap** with a superior and medial pedicle to repair a **medial canthal defect** (see Figs. 5.3–5.7, 9.5, and 9.13).

10 The Auricular Region

Central Defects

Concha

Small defects of the concha can be repaired with a full-thickness retroauricular skin graft.

Postauricular Island Flap

(Fig. 10.1)

Two-layer defects of the concha or anthelix can be repaired with a subcutaneously based postauricular and retroauricular island flap.

Superiorly or Inferiorly Based Transposition Flap

(Fig. 10.2a, b)

A superiorly (Fig. 10.2a) or inferiorly based transposition flap (Fig. 10.2b) is de-epithelialized at the pull-

through site (Fig. 10.2a, b) and inset into the conchal defect (Fig. 10.2c). Occasionally it is necessary, in a second stage, to divide the pedicle and return the remainder to its original site.

Temporary Separation of the Helix (Weerda 1984)

(Fig. 10.3)

Larger two-layer and three-layer defects involving the anthelix and concha can be repaired with a superiorly or inferiorly based transposition flap. If necessary, the postauricular surface is covered with a rotation flap. The helical rim can be temporarily sectioned and separated (Fig. 10.3a–c). In a second stage 18–22 days later, the healed flap is divided and the helix reapproximated. The rest of the pedicle is then returned to the mastoid area (Fig. 10.3d).

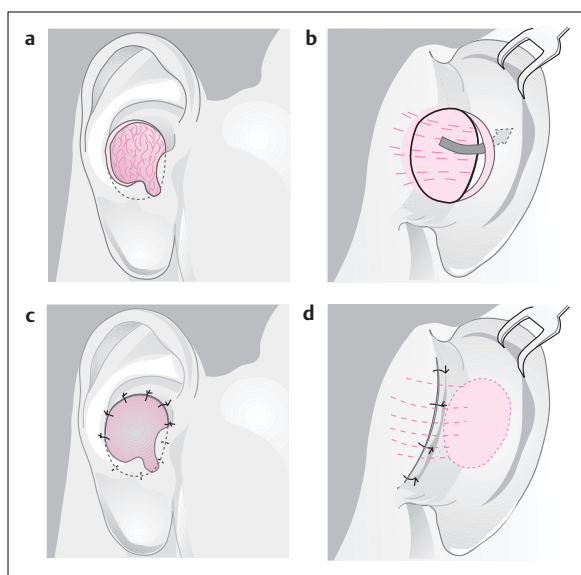


Fig. 10.1

- a Conchal defect
- b Retroauricular and postauricular island flap with a subcutaneous pedicle (posterior auricular artery).
- c The island flap is pulled through into the defect and sutured into place (anterior side).
- d The secondary defect is closed by direct suture (posterior side).

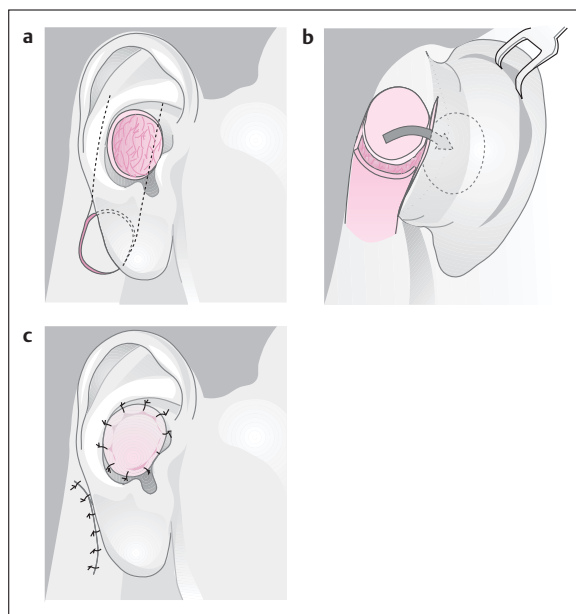


Fig. 10.2 Conchal defect

- a Superiorly based retroauricular transposition flap with a de-epithelialized area.
- b Inferiorly based transposition flap (alternative to a).
- c All defects are closed. Generally the pedicle is divided and inset in a second stage about 3 weeks later.

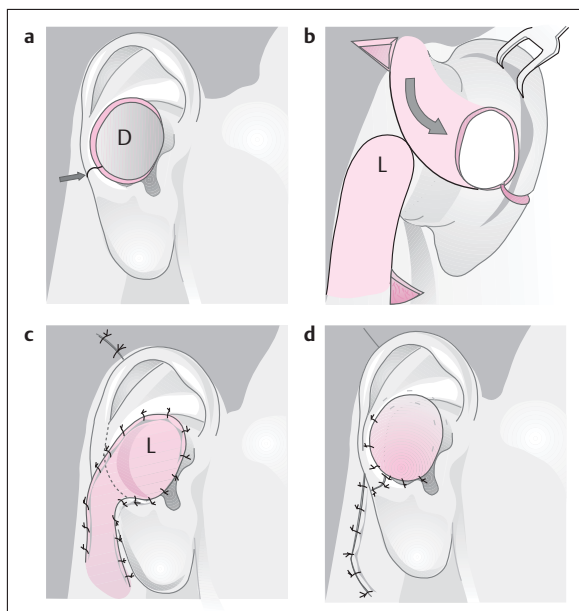


Fig. 10.3 Temporary separation of the helix for a **large, three-layer auricular defect** (after Weerda 1984).

- a** Conchal defect (D). The helix is sectioned above the earlobe (arrow).
- b** An inferiorly based transposition flap (L) is used for the anterior repair. The posterior side is covered with a rotation flap (or thick split skin graft).
- c** The flaps are inset.
- d** About 3 weeks later the transposition flap is divided and replaced, and the helix is reapproximated.

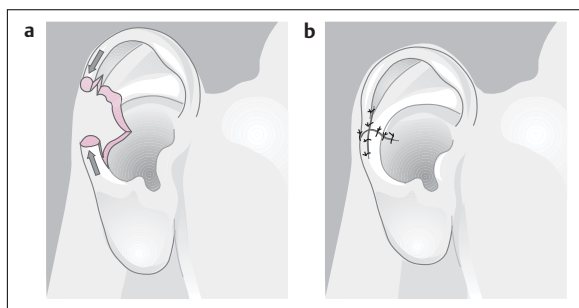


Fig. 10.4 **Wedge-shaped resection** (up to 2 cm of the helical rim).

- a** Burow's triangles are incorporated into the resection to prevent auricular distortion.
- b** The defects are closed.

Peripheral Defects

Helix

Tumor Resection and Helical Defect Closure with a Decrease in Auricular Size

a) Wedge-shaped resection (Fig. 10.4)

A helical defect caused by a small tumor resection or injury can be closed by extending the defect to a wedge shape (Fig. 10.4a). Small, full-thickness

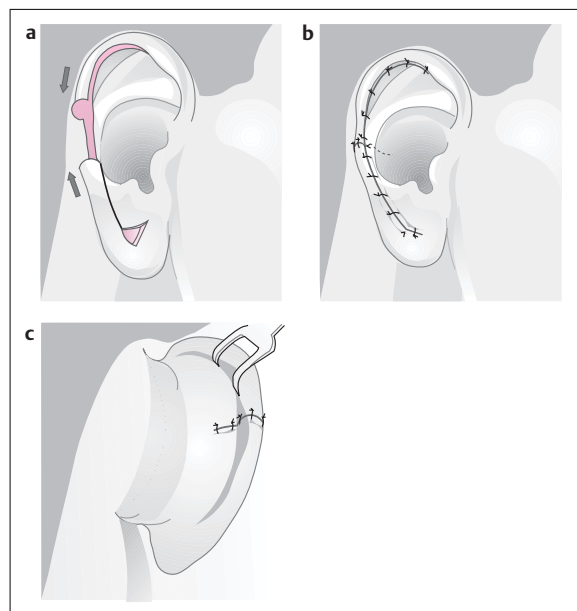


Fig. 10.5 **Small helical resection defect** repaired by the Gersuny technique (1903) (Weerda modification).

- a** Following tumor resection, a curved two-layer incision is made in the scapha, and a Burow's triangle is excised in the earlobe.
- b** The entire helix is mobilized on the postauricular skin, and the wounds are closed.
- c** A dog ear is excised on the postauricular surface.

Burow's triangles ensure a very good esthetic result (Fig. 10.4b).

b) Gersuny technique (1903) (Fig. 10.5)

Defects in various portions of the helix can be repaired with a slight decrease in auricular size by cutting along the scapha and excising Burow's triangles from the earlobe and the postauricular skin (Fig. 10.5a, c).

c) Modification of Antia (1974) (Fig. 10.6)

As in the Gersuny technique, defects are closed by cutting along the scapha and advancing the helix and the crus, which is incised around its perimeter (see Fig. 10.9a–c).

d) Z-plasty technique of Weerda (1980) (Fig. 10.7)

An acquired wedge-shaped helical defect or a congenital coloboma can be closed by an auricular Z-plasty (Fig. 10.7). Argamaso and Lewin (1968) and Spira (1974) described a similar technique (Fig. 10.8).

e) Anterior superior auricle (Weerda 1989) (Fig. 10.9)

With defects in the anterior superior auricle, the preauricular defect can be closed with a rhomboid-shaped Dufourmentel flap (Fig. 10.9a) or a transposition flap (see Figs. 3.26, 8.13, and 8.24). The Gersuny technique (see Fig. 10.5) can then be used to repair the upper anterior helix (Fig. 10.9b).

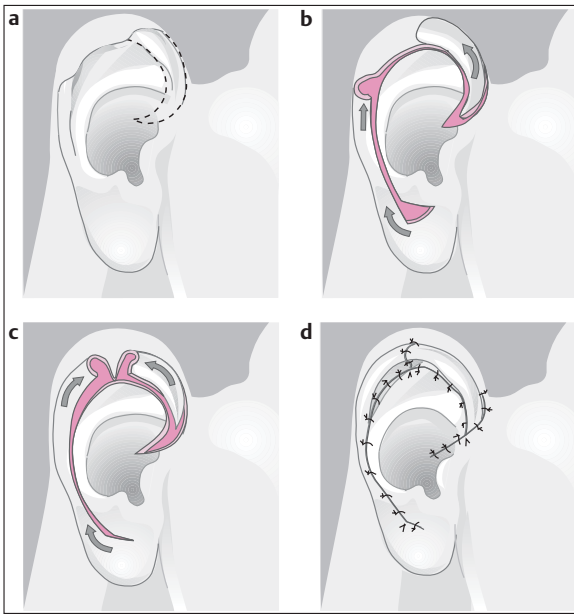


Fig. 10.6 **Small helical defect** reconstructed by the technique of Antia and Buch (1967) (see Fig. 10.5).

- a** The wound edges are freshened.
- b** An incision is made around the crus, and the postauricular skin is dissected.
- c** An incision is made along the scapha into the earlobe, and a small Burow's triangle is excised.
- d** Closure of the defects does not significantly decrease auricular size.

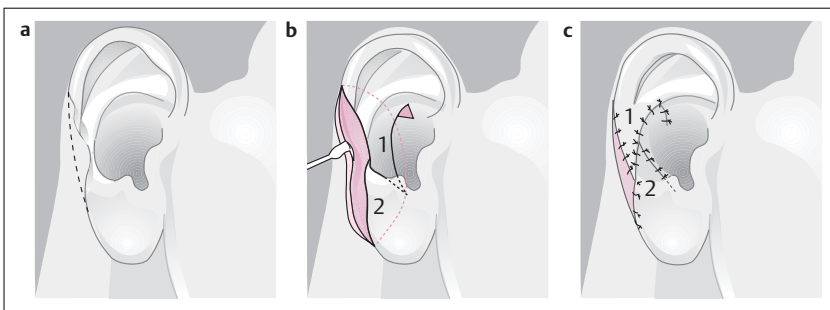


Fig. 10.7 **Lateral defect** closed by the Z-plasty technique of Weerda (1980).

- a** Defect.
- b** The wound edges are freshened, and two-layer acute-angled flaps are cut, one based superiorly (1) and the other inferiorly (2). The postauricular skin is mobilized.
- c** The flaps are transposed, closing the defect and drawing the earlobe upward.

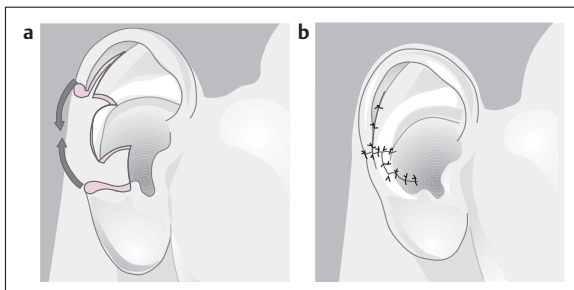


Fig. 10.8 **Lateral defect** closed by the technique of Argamaso and Lewin (1968).

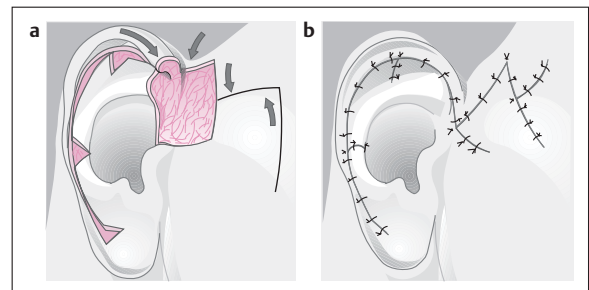


Fig. 10.9 **Preauricular and crus defect**.

- a** A preauricular Dufourmental flap is cut (see Figs. 3.26, 8.13, 8.18, and 8.24), and the helix is shifted forward as in our modified Gersuny technique (see Fig. 10.5).
- b** The completed repair.

Reconstruction of Helical Defects with Preservation of Auricular Size

a) The crus helix (Fig. 10.10)

Crus defects are reconstructed with a superiorly based preauricular transposition flap (Fig. 10.10a, b).

b) Small helical defect: transposition flap and bipedicle flap (Figs. 10.11 and 10.12)

First stage: A small helical defect can be reconstructed with a superiorly or inferiorly based transposition flap (Fig. 10.11) and a slightly longer defect with a bipedicle flap (Fig. 10.12) supported by cartilage from the ipsilateral concha or opposite ear.

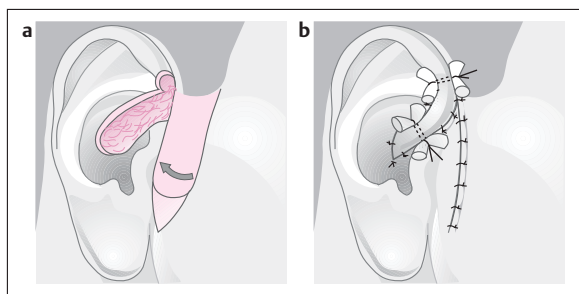


Fig. 10.10 Reconstruction of the crus.

- a Superiorly based preauricular transposition flap (hairless).
- b The flap is sutured into the defect. The crus is shaped with two small bolster sutures tied over pledgets or silicone film.

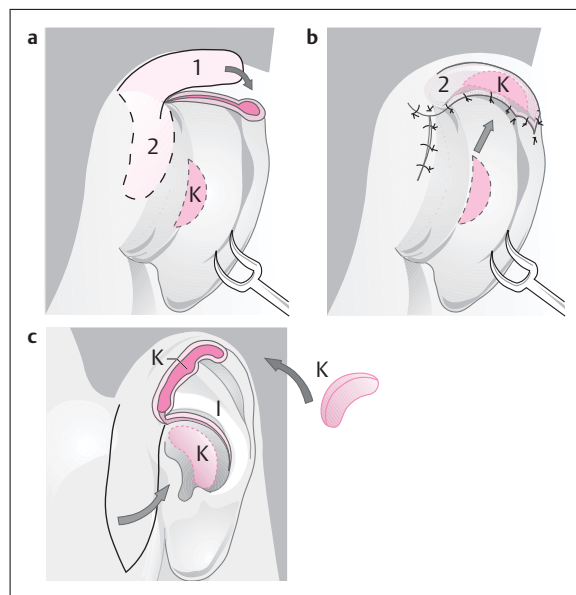


Fig. 10.11 Small defects of the upper helix.

- a Small inferiorly based (1) or superiorly based (2) transposition flap (the latter from the retroauricular sulcus) is used to reconstruct the upper helix.
- b The flap is inset, giving it a "fish mouth" configuration along the helix.
- c Use of a preauricular flap (K: cartilage strut from the concha. I: skin incision in the concha at the border of the anthelix).

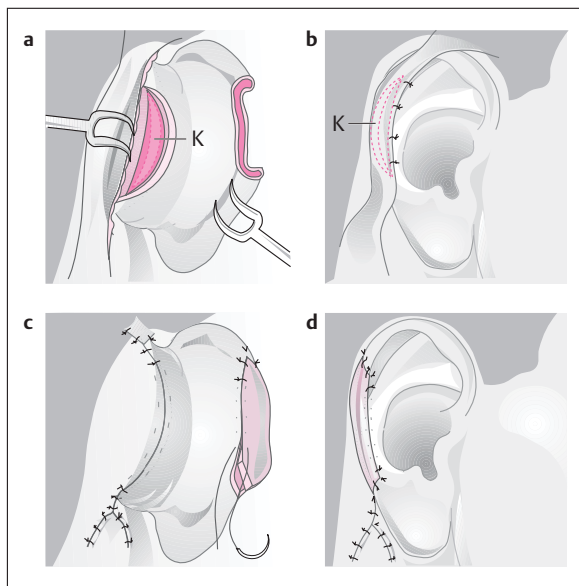


Fig. 10.12 Reconstruction of a long helical defect with a bipedicle flap.

- a Cartilage (K) from the concha, accessed through the donor defect for the bipedicle flap in the sulcus.
- b After the cartilage strut is sewn into place, the bipedicle flap is inset into the defect, whose edges have been freshened.
- c Three weeks later the flap is divided and the tips are inset into the helical defects. The bipedicle flap is inset into the sulcus in the mastoid area.
- d Appearance on completion of the second stage.

Second stage: About 3 weeks later, the flaps are divided and inset into the upper and lower helix and earlobe (Figs. 10.11b and 10.12c, d).

Partial Auricular Defects

Upper Third Defects

If insufficient skin is available above the avulsion or defect, the skin should be expanded over a 6–8-week period using a 10-mL tissue expander (see also Figs. 4.5, 5.53 and Fig. 10.16). Generally, however, there will be sufficient local skin for the reconstruction.

First stage: A transparent film pattern is traced from the opposite, normal ear (Fig. 10.13). Then rib car-

tilage is harvested from the ipsilateral or contralateral side (see Figs. 11.1 and 11.3), and a delicate auricular framework is carved from the autogenous material (Figs. 10.14 and 11.3). The framework should be **3 mm smaller in all dimensions** than the traced pattern. It is stitched to the auricular stump with 4–0 or 5–0 Vicryl sutures and implanted into the prepared subcutaneous pocket, which should be approximately 1 cm larger than the height of the framework (Fig. 10.15a). The skin of the pocket is stitched to the anterior skin of the auricular stump (freshened) with interrupted 6–0 or 7–0 monofilament sutures. The helix is shaped with bolster sutures (Fig. 10.15b), and a suction drain is inserted (for about 6–7 days) to promote skin coaption to the frame.

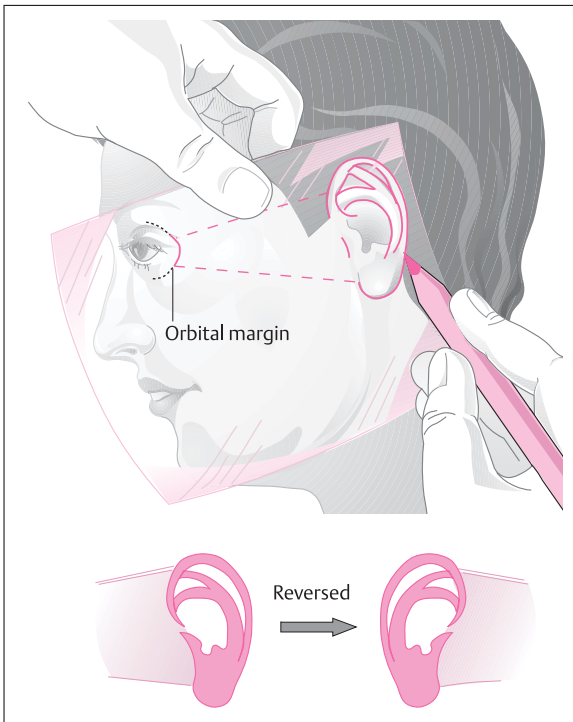


Fig. 10.13 A **pattern** is traced from the normal ear on a sheet of transparent material (e.g., radiographic film), which is held against the orbital margin. The auricle is traced, and the scapha, triangular fossa, and concha are cut out.

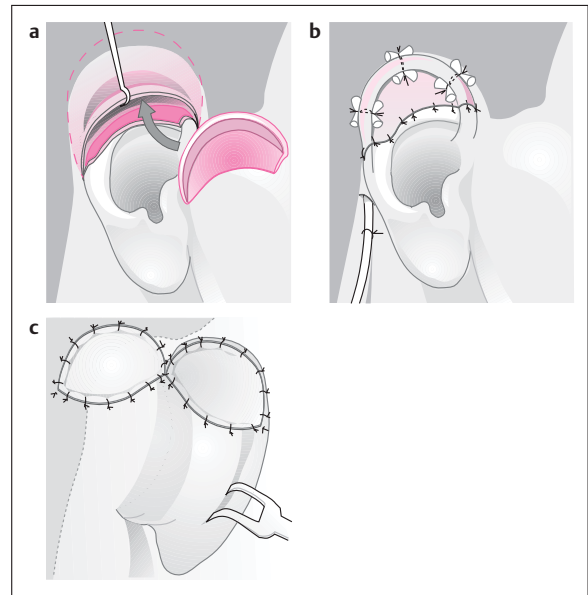
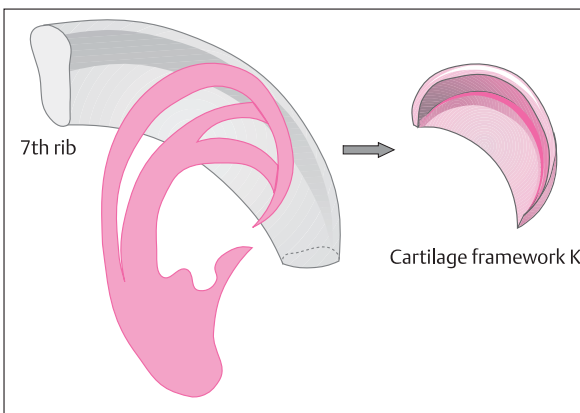


Fig. 10.15 **Partial avulsion of the upper auricle.**

- A retroauricular incision is made at, or preferably just below, the level of the auricular stump. A subcutaneous pocket is developed; it should be about 1 cm larger than is necessary to accommodate the cartilage framework. The framework may consist of native auricular cartilage cleared of skin (after an avulsion) or a framework carved from autogenous rib cartilage (see Figs. 10.13 and 10.14). The framework is inserted into the pocket and attached to the cartilage of the stump.
- The skin on the **back of the stump** is sutured to the lower, retroauricular **wound margin**. The **upper wound margin** of the pocket is sutured to the anterior side of the stump (with 6-0 monofilament). Bolster sutures and a suction drain coapt the skin to the underlying framework.
- The auricle is lifted from its bed 6-8 weeks later, and the split-thickness skin previously obtained from the buttock or thorax scar is stitched and glued to the raw surfaces on the back of the ear and the mastoid (skin grafts should be 0.35-0.40 mm thick).

◁ Fig. 10.14 A delicate **cartilage framework** is carved using the film pattern as a guide (sixth, seventh, or eighth rib). The pattern is reversed to carve the cartilage framework (K) for the opposite ear.

Second stage: The auricular skin is incised 6-8 weeks later and the framework is elevated from the mastoid (see Fig. 10.31a, b), taking care to preserve a good connective-tissue layer on the cartilage. The resulting defects are covered with thick split or full-thickness skin obtained from the thoracic donor site, groin, or buttock (Fig. 10.15c). Reconstruction with an anteriorly based flap employs a similar technique (Fig. 10.16).

Middle Third Defects

Burow's Retroauricular U-Advancement Flap (Fig. 10.17)

Middle third defects of the helix (Fig. 10.17) can be reconstructed with a broad, posteriorly based flap that is raised in the postauricular sulcus (Fig. 10.17a) and dissected toward the scalp. After raising the flap, we use a film pattern as a guide to make a supportive

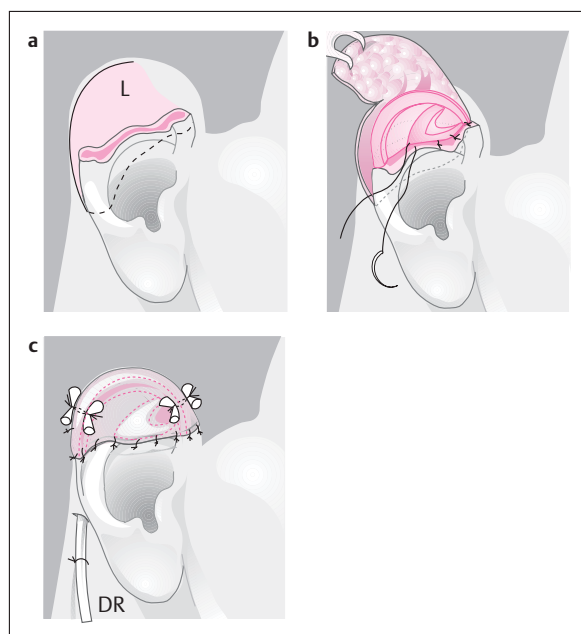


Fig. 10.16 **Reconstruction of the upper auricle** with an anteriorly based flap (L).

- a The flap is cut along the stump in the sulcus and superiorly along the hairline.
- b The cartilage framework is sutured to the stump. The skin on the back of the auricle is sutured to the lower wound margin in the sulcus.
- c The flap is sutured to the anterior auricular skin and above the cartilage framework. It is coapted to the framework with bolster sutures and a suction drain (DR).

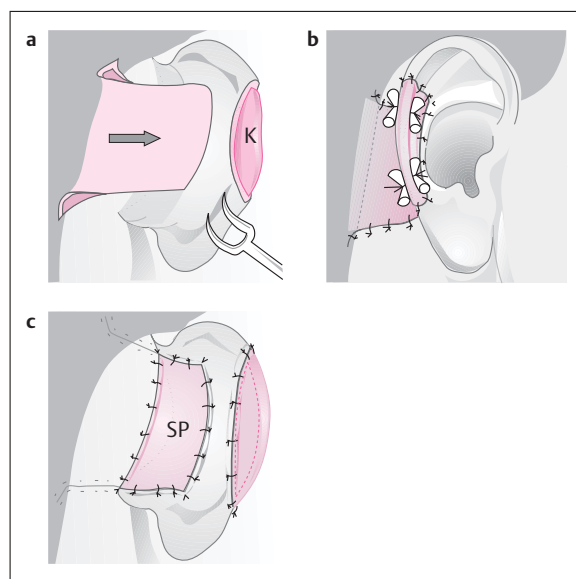


Fig. 10.17 **Small middle third defect** repaired with a U-advancement flap.

- a The wound edges are freshened, and a cartilage framework (K) is implanted. A postauricular U-flap based on the scalp is raised in front of the sulcus.
- b This flap is sutured to the anterior skin of the stump and coapted to the framework with bolster sutures.
- c Three weeks later the flap is divided and inset behind the ear. A split-thickness skin graft (SP) may be used to cover the residual defect.

framework from conchal or rib cartilage before suturing the flap into place (Fig. 10.17b).

In the **second stage** 3–4 weeks later, the flap is divided and inset (Fig. 10.17c). The residual defect is grafted with thick split skin.

Transposition-Rotation Flap of Weerda (1980b)

(Fig. 10. 18)

If an ordinary advancement flap is inadequate, a transposition flap can be brought to the correct retroauricular position by raising a rotation flap behind the hairline in the same sitting (Fig. 10. 18a). Generally this flap is sufficient for both the anterior and posterior sides of the auricular reconstruction. This technique eliminates the need for a second stage (Fig. 10.18b, c).

Larger Middle Third Defects

(Fig. 10.19)

As in the reconstruction of large upper third defects (see Fig. 10.15), a skin pocket is developed behind the ear (Fig. 10.19a). A carved piece of rib cartilage is sutured to the cartilage stump and inserted into the pocket (see Figs. 10.14–10.16). The skin is closed with 6–0 monofilament suture material and coapted with 5–0 monofilament bolster sutures (Fig. 10.19a). A suction drain is inserted for 6–7 days (see Fig. 10.16c).

Second stage: The auricle is lifted from its bed (Fig. 10.19b, c), and the defects are closed with split-thickness skin (0.32–0.40 mm). The second and third stage (if necessary) are the same as for an upper third defect (Fig. 10.17).

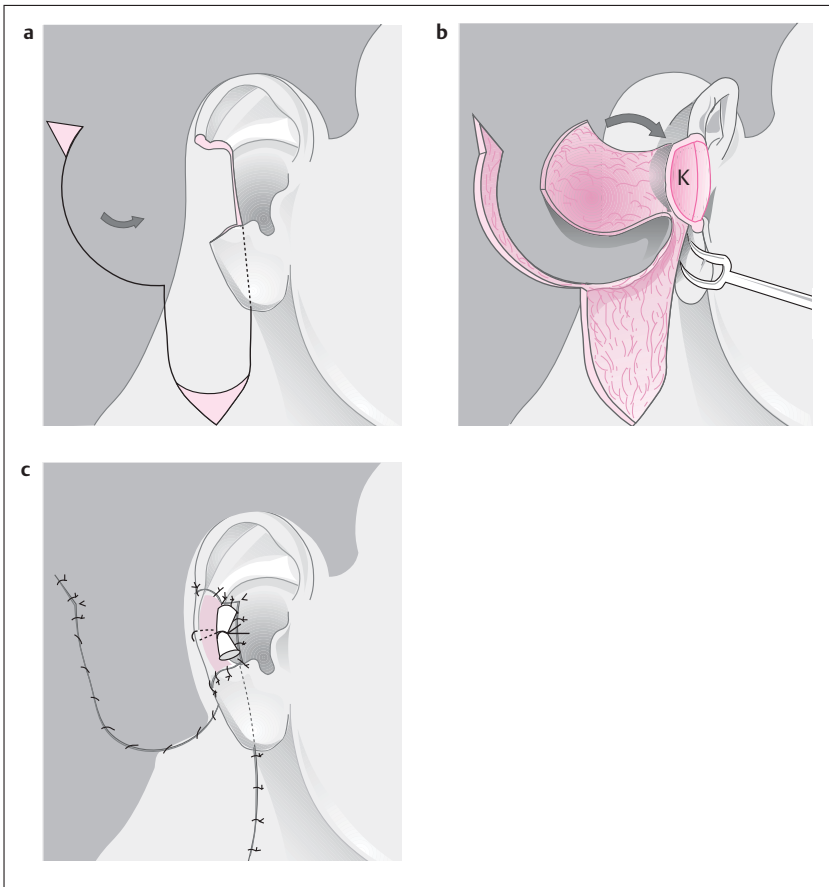


Fig. 10.18 Reconstruction of a **large middle third auricular defect** with a rotation-transposition flap (Weerda 1981).

- a Outline of the rotation-transposition flap. The hairless retroauricular transposition flap (**reconstruction flap**) is moved to the correct retroauricular position by means of a hair-bearing rotation flap (**transport flap**).
- b The transposition flap is now behind the defect. The supportive cartilage graft (K: occupies the defect 3 mm smaller). The surrounding skin is mobilized.
- c Appearance after one-stage reconstruction of the anterior and posterior sides.

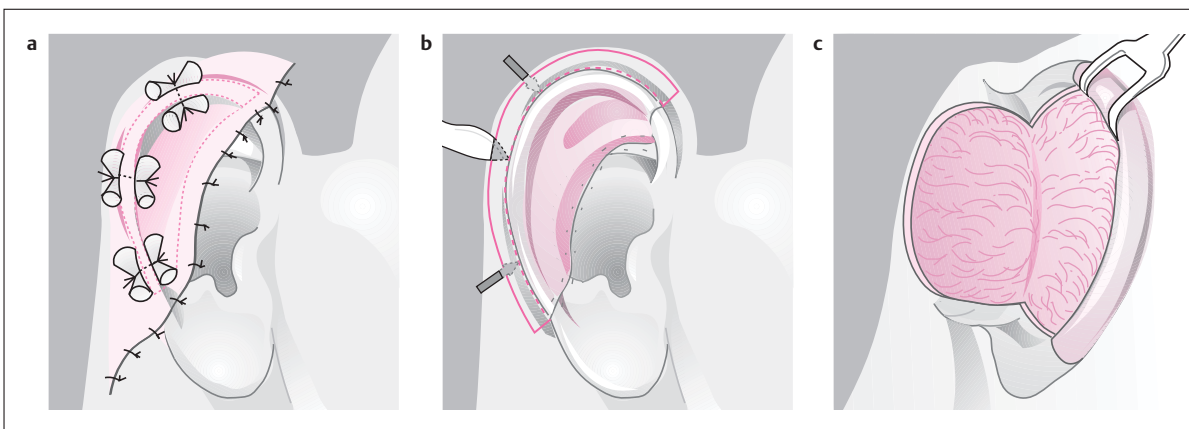


Fig. 10.19 Reconstruction of a **large middle third auricular defect**.

- a **Step 1:** The stumps are freshened, and the skin surrounding the defect is mobilized. A cartilage framework is inserted (see Figs. 10.15 and 10.16) and attached to the cartilage stump. The skin is sutured to the anterior skin of the auricular stump and coapted to the framework (a large U-advance flap may be required; see Figs. 10.16 and 10.17).

- b **Step 2:** An incision is made 1–1.5 cm behind the cartilage margin, and a thick split skin flap is dissected close to the helical rim with a No. 15 blade.
- c The new posterior auricular surface is carefully dissected, preserving the connective-tissue layer on the cartilage framework. The split-thickness skin flap is folded over. The mastoid defect is reduced in size, and the residual defect is grafted with split-thickness skin from the scalp, groin, buttock, or old thoracic wound (see Fig. 10.31).

Lower Third Defects

Earlobe Reconstruction by the Gavello Technique

(Fig. 10.20)

We very often use the double-flap technique of Gavello for earlobe reconstructions (Fig. 10.20a). After the defect is freshened, the flap is folded over and sutured to the stump (Fig. 10.20b, c). The donor defect is closed by direct approximation, placing the lower wound margin as far behind the auricle as possible. If necessary, the reconstruction can be supported by a cartilage graft from the concha of the opposite ear or from the rib (Fig. 10.21a, b). This requires making the anterior flap slightly larger than the posterior flap. Brent (1976) described a similar flap for reconstructing larger lower third defects of the auricle. We have modified this flap (Fig. 10.21). A framework carved from rib cartilage is implanted to prevent shrinkage of the reconstructed lower third (Fig. 10.21c; see also Figs. 10.15 and 10.16).

Weerda's Modification of the Gavello Flap

(Fig. 10.22)

If the earlobe and portions of the helix have been lost, a small tubed flap can be added to the Gavello flap to reconstruct the helix (Fig. 10.22a). It may be necessary to design the base of the flap slightly broader initially and to narrow it later (Fig. 10.22b, c).

Earlobe Reconstruction by the Alanis Technique

(Fig. 10.23)

The lower part of the Alanis flap tapers downward to a sharp angle and is folded upward to form the posterior part of the earlobe (Fig. 10.23a, b). The disadvantage of this flap is that it leaves a visible scar (Fig. 10.23c).

Earlobe Reconstruction in Two Stages

Analogous to a total auricular reconstruction (see Fig. 10.31), the first stage consists of developing a pocket and inserting a cartilage graft. In a **second**

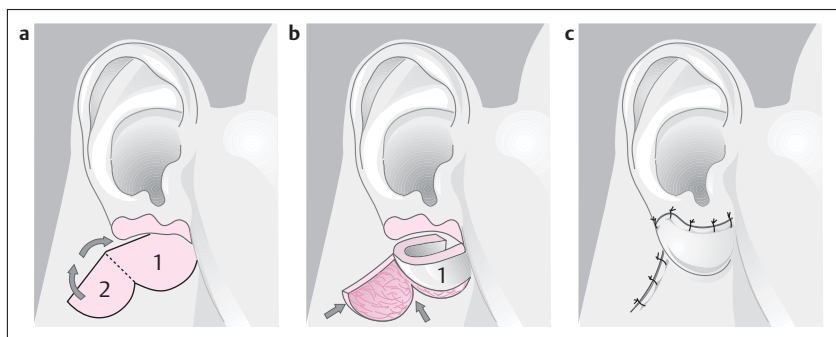


Fig. 10.20 Reconstruction of the earlobe by the technique of Gavello.

- a An anteriorly based, bilobed flap is prepared below the auricular defect. We recommend using a pattern made of aluminum foil (e.g., from a suture package).
- b The posterior flap (2, Fig. 10.20a) is folded behind the anterior one (1).
- c The wounds are closed. (The inferior skin is mobilized to place the scar behind the auricle.)

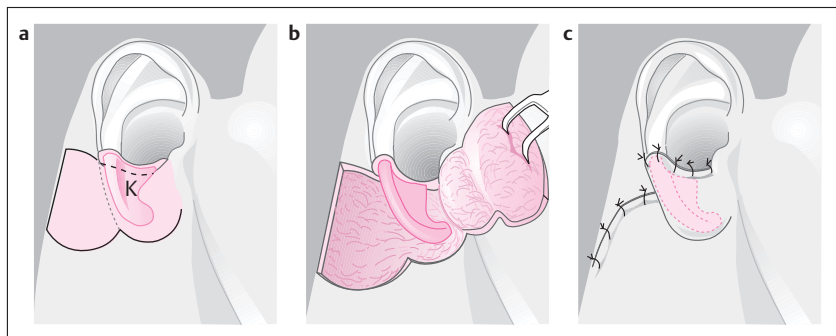


Fig. 10.21 Reconstruction of the lower auricle by the technique of Brent (1976, modified).

- a Outline of a large, anteriorly based, bilobed Gavello flap.
- b The flap is raised, and a cartilage framework is sutured into place.
- c The framework is covered with the flap, and all defects are closed.

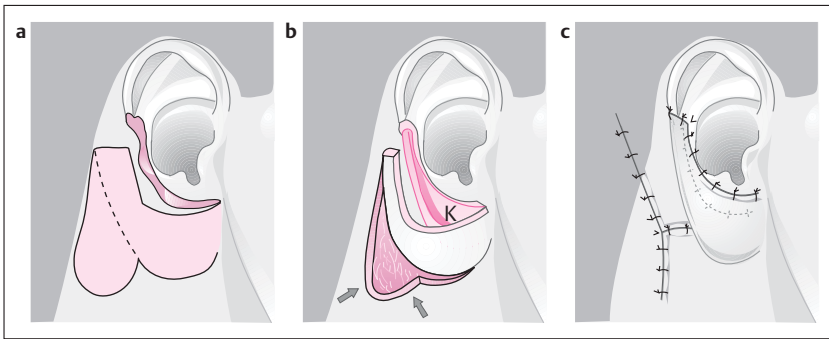


Fig. 10.22 Weerda's modification of the Gavello technique with **reconstruction of the lower helix**.

- a Outline of the flap.
- b The flap is inset around a cartilage framework carved from the concha or a rib (3 mm smaller).
- c The reconstruction is completed.

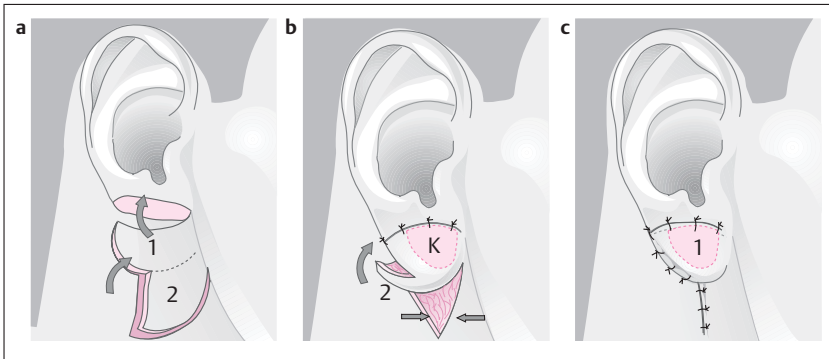


Fig. 10.23 **Earlobe reconstruction** by the technique of Alanis (1970).

- a The defect is freshened, and a bilobed flap is cut to form the anterior side (1) and posterior side (2) of the proposed earlobe. The anterior flap (1) is slightly larger than the second flap.
 - b Flap 1 is sutured into place, and flap 2 is folded under to cover the posterior side.
 - c All defects are closed (a minor disadvantage is the visible scar below the earlobe).
- K = cartilage support

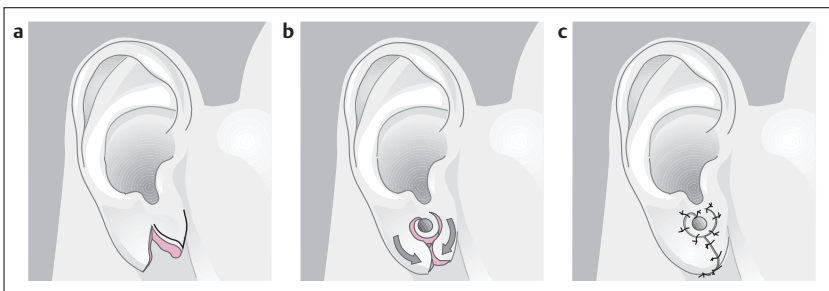


Fig. 10.24 **Cleft earlobe** caused by an earring avulsion.

- a A thin flap is cut from one side of the cleft, and the wound edges are freshened.
- b, c The epithelial flap is rolled inward to create a new channel for earring use.

stage the auricle is raised from its bed, and the post-auricular area and defect are grafted with full-thickness or split-thickness skin (see Figs. 10.15, 10.17 and 10.19).

Acquired Earlobe Cleft

(Fig. 10.24)

A small epithelial flap is created (Fig. 10.24a), and the wound edges are freshened. If the earlobe is too long, it is shortened slightly and the subcutaneous and cu-

taneous wounds are closed with 6-0 or 7-0 monofilament sutures (Fig. 10.24b, c).

Earlobe Reduction

(Fig. 10.25)

A variety of simple incision techniques can be used, as illustrated.

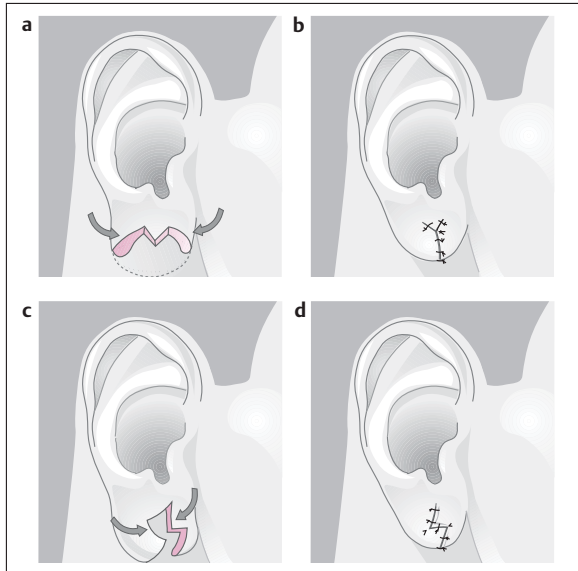


Fig. 10.25 a–d Closure of **earlobe defects** (reducing the size of a hypertrophic earlobe).

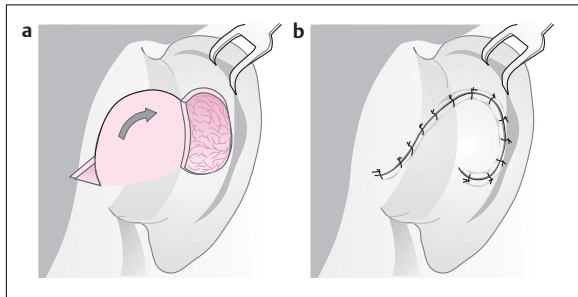


Fig. 10.26 Two-layer defect in the **postauricular surface** repaired with a **rotation flap**.
a Outline of the flap.
b The completed repair.

Postauricular Surface

Smaller defects in the postauricular surface can be repaired with an advancement flap (see Fig. 3.12), rotation flap (Fig. 10.26), or transposition flap (Fig. 10.27). Larger defects can be covered with a Burow's U-flap (see Fig. 10.17) or with the rotation-transposition flap described by Weerda (1980; Figs. 10.18 and 10.28).

Subtotal Defects of the Auricle

Subtotal auricular defects are classified by their location as upper third (see Fig. 10.16), middle third (see Figs. 10.18 and 10.19), or lower third (see Figs. 10.20–10.22). For subtotal defects in which the helix or an earlobe remnant is preserved, we have developed a

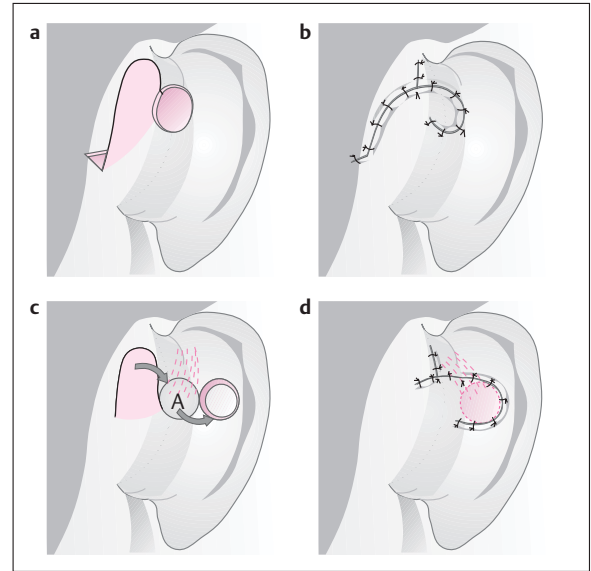


Fig. 10.27 a Two-layer defect in the **postauricular surface** repaired with a **transposition flap**.
b The completed repair.
c Closure of a three-layer defect. The anterior side is repaired with a superiorly or inferiorly subcutaneously based island flap (A), the posterior side with a transposition flap (see Figs. 10.1 and 10.2).
d The completed repair.

special rotation-transposition flap with a bilobed design (Fig. 10.28). This flap is particularly useful in cases where skin or skin and bone have been resected in the mastoid area. Since the transposition flap is de-epithelialized (Fig. 10.28a), the anterior and posterior sides can be reconstructed in one sitting. As in other repairs, a rib cartilage framework is implanted for structural support.

Loss of the Auricle

Fresh Avulsion Injuries

Microvascular Replantation

Microvascular replantation of the avulsed ear should be attempted whenever possible (Pennington et al. 1980). The success rate is 23% (Weerda and Siegert 1998).

Replantation of the Auricular Cartilage

Analogous to auricular reconstruction with rib cartilage, the skin of the avulsed ear can be removed and the auricular cartilage implanted into a pocket developed in the area above and behind the defect (see Figs. 10.15, 10.18, and 10.30). The cartilage is sutured to the auricular cartilage stump and inserted into the pocket, and the skin of the pocket is sutured to the skin of the stump (see Figs. 10.15, 10.18, and 10.30).

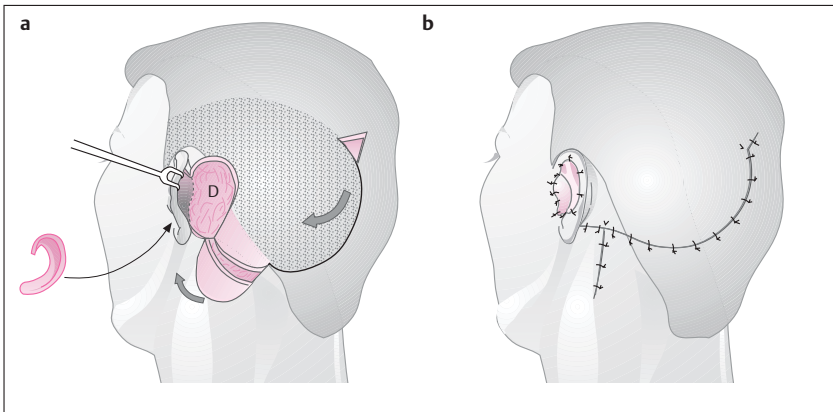


Fig. 10.28 **Subtotal auricular defect** with preservation of the helix and earlobe and an accompanying defect in the mastoid area, repaired with a rotation-transposition flap designed by Weerda (1981).

- a Outline of the hair-bearing rotation flap (**transport flap**) and hairless transposition flap (**reconstruction flap**). The flap is de-epithelialized at the pull-through site, and a cartilage framework is implanted (see Fig. 10.18).
- b The completed repair.

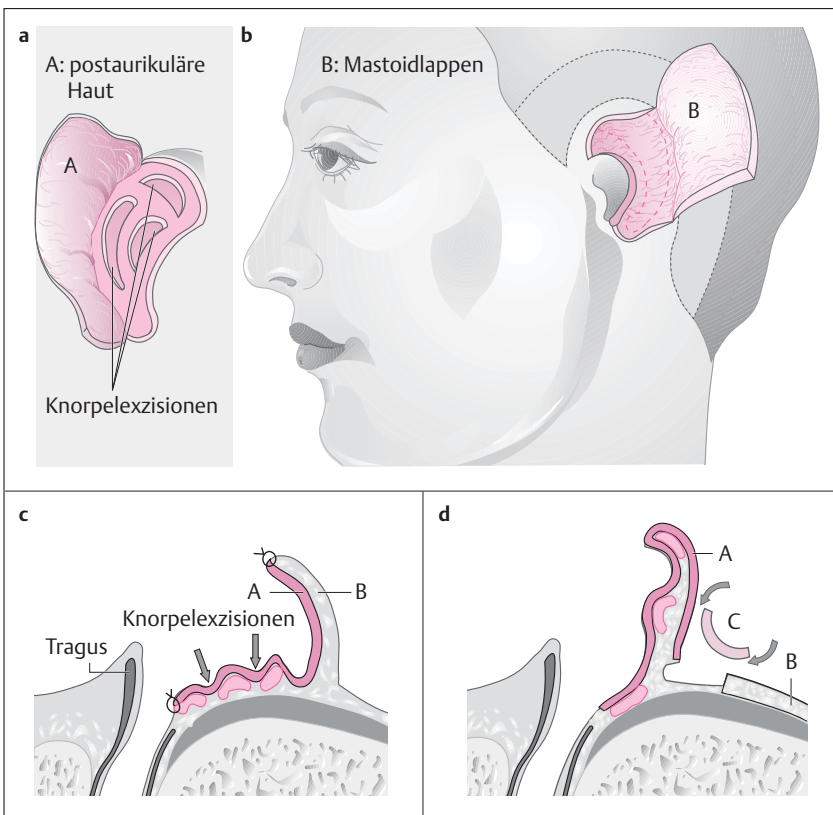


Fig. 10.29 **Replantation of an avulsed auricle** by the technique of Baudet (1972) as modified by Arfai (1974).

- a Preparation of the posterior side of the avulsed auricle. The skin is dissected back to the helical rim as a full-thickness skin flap (A). The auricular cartilage is fenestrated by excising segments down to the perichondrium on the anterior side of the auricle.
- b Preparation of the **recipient bed** on the mastoid. The flap (B) is developed toward the scalp, creating a large raw surface.
- c **First stage:** The fenestrated cartilage is sutured and glued to the recipient bed. The postauricular skin flap (A) is attached to the mastoid flap (B) with sutures and glue.
- d **Second stage:** Three weeks later the postauricular flap (A) is separated from the mastoid flap (B), and both flaps are returned to their original positions. Residual defects are grafted with split-thickness skin (C).

Replantation by the Technique of Mladick (1971)

In this technique the amputated ear part is dermabraded with a large diamond or corundum wheel, then inserted into a retroauricular skin pocket and sutured to the stump, as in the replantation of auricular cartilage. Four weeks later the skin pocket is opened, the largely epithelialized segment is taken from the pocket, and the skin of the pocket is fixed in the retroauricular sulcus. The replantation of small auricular segments by the Mladick technique has a success rate of approximately 65% (Weerda and Siegert 1998).

Auricular Replantation by the Technique of Baudet (1972) and Arfai (1974) (Weerda 1980) (Fig. 10.29)

The replantation of ear parts is doomed to failure in most cases (Weerda et al. 1986). The overall success rate reported in the literature is approximately 30%. **First stage:** Avulsed ear parts should be kept cool and clean by placing them in a moist paper towel or special box for delivery to the operating room. Small auricular composite grafts can be successfully replanted even after 24 hours, but necrosis increases with the size of the replanted part and the duration

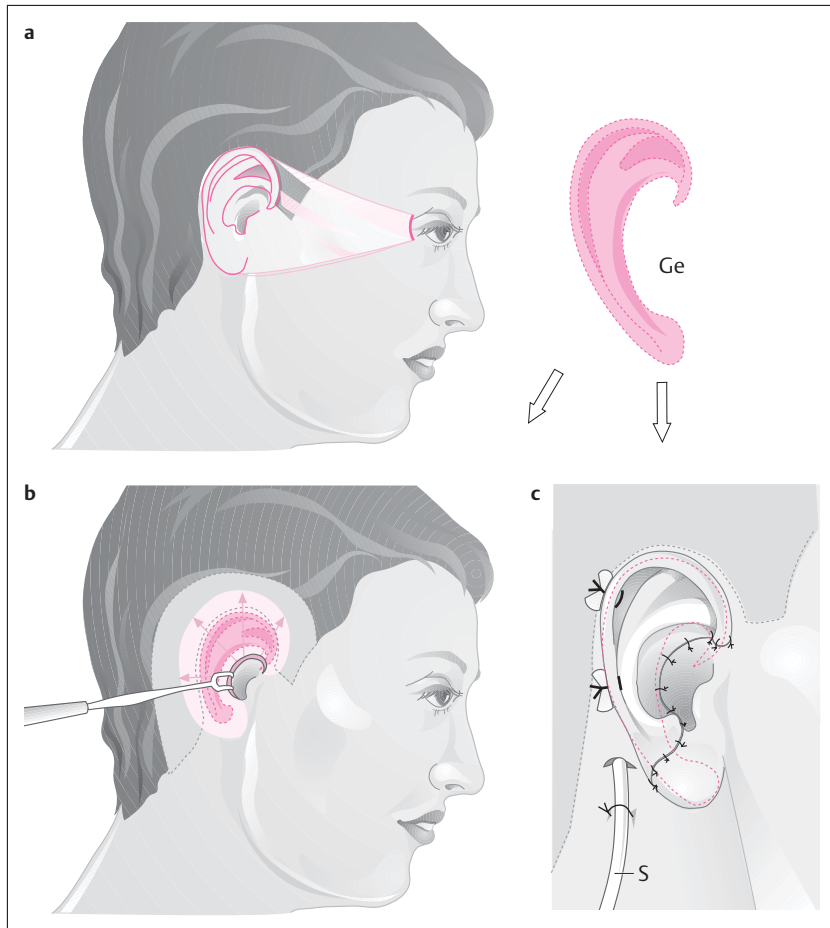


Fig. 10.30 Auricular reconstruction after total amputation.

First stage:

- a** The film pattern traced from the opposite ear is reversed to determine the precise position of the reconstructed ear (see Fig. 10.13). Its position is also determined by the auricular remnants.
- b** The old wound is opened, the scars are carefully excised, and the skin is undermined. The old wound edges are freshened, and the cartilage framework (Ge) is implanted (see Fig. 11.3).
- c** The wound is closed. The earlobe remnant is placed at the anatomically correct site, and the skin is coapted to the framework by a suction drain (S) and several bolster sutures.

of exposure to room temperature. The procedure described by Baudet (1972) and later by Arfai (Fig. 10.29) increases the raw surface in the mastoid area and promotes anterior revascularization by fenestrating the salvaged cartilage (Fig. 10.29a–c).

Second stage (Fig. 10.29d): After 4–8 weeks the auricular skin flap (Fig. 10.29a, A) can be separated from the mastoid flap (Fig. 10.29b, c; B). The auricle is raised from the mastoid plane as in a total ear reconstruction, and the flaps are returned. Residual defects are covered with a thick split or full-thickness skin graft (Fig. 10.29d). The reported success rate is approximately 40% (Weerda and Siegert 1998). If the earlobe is missing, it is reconstructed by the Gavello technique (see Fig. 10.18).

Auricular Reconstruction Following Total Amputation

(Fig. 10.30; Weerda 1983c, 1987, 1997, Weerda and Siegert 1998)

When the entire auricle has been lost as a result of accidental trauma or tumor surgery, generally there is enough skin left to proceed with reconstruction. Otherwise the available skin should be expanded by implanting a 20–35-mL tissue expander for approximately 8 weeks (Siegert and Weerda 1994; see Figs. 4.5 and 5.53).

First stage: First a pattern is traced from the opposite, normal ear onto a sheet of radiographic film or other transparent material (see Figs. 3.8 and 10.14). The pattern is reversed, the position of the new auricle is precisely determined (Fig. 10.30a), and a skin pocket is developed past the hairline (Fig. 10.30b). The skin should be dissected thin enough to conform well to the underlying framework but thick enough to preserve an adequate blood supply. After the rib cartilage has been harvested (see Fig. 11.1), a cartilage framework is carved from the synchondrosis of the ipsilateral or contralateral sixth and seventh ribs. The framework should be 3–4 mm smaller in all dimensions than the proposed auricle (see Fig. 11.3).

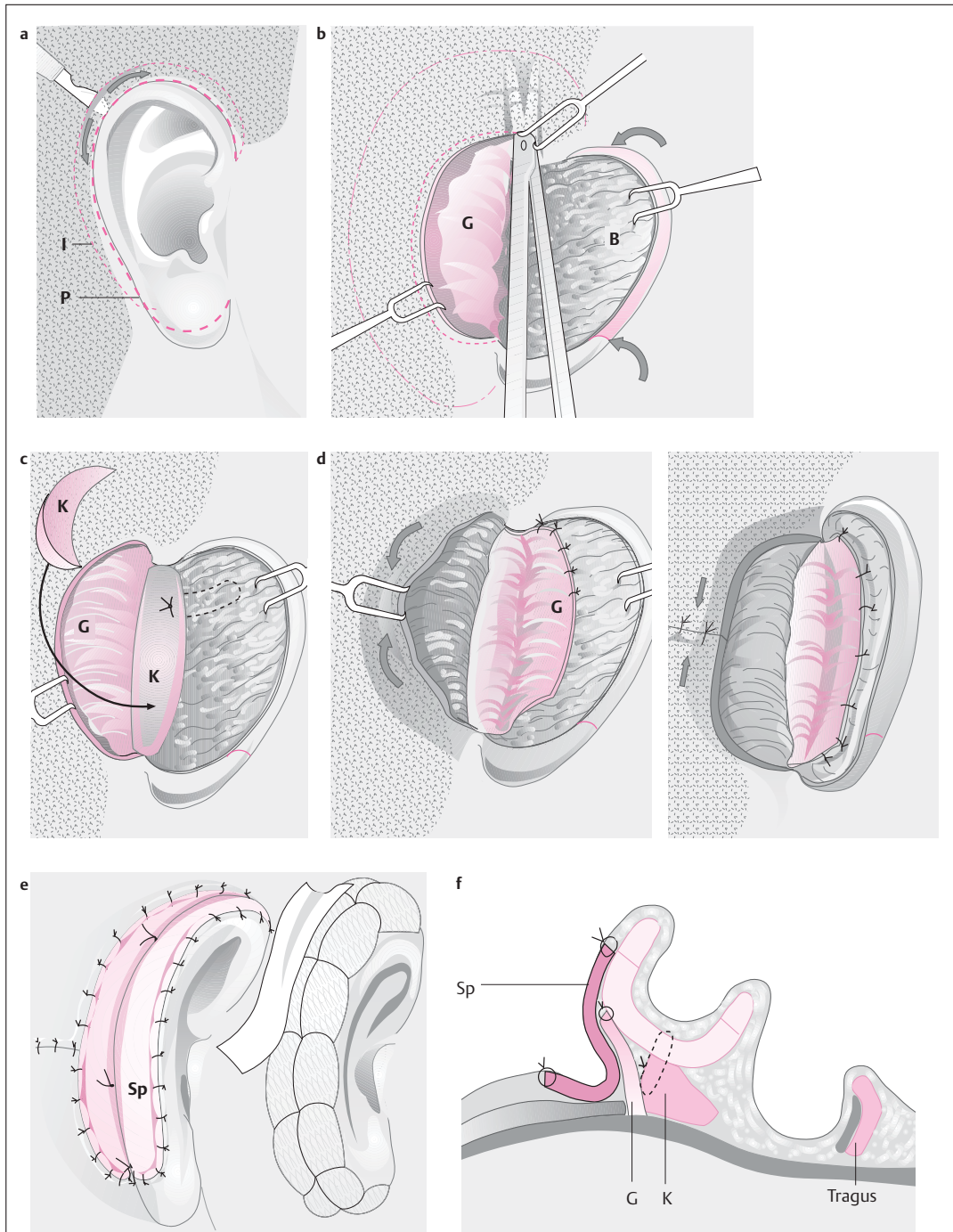


Fig. 10.31 **Second stage** of auricular reconstruction about 6 weeks later.

- a An incision is made 1–1.5 cm above and behind the rim of the framework. A full-thickness skin flap is dissected with a No. 15 scalpel above the level of the hair bulbs, developing to flap close to the framework (P = limit of the dissection). The framework itself should not be exposed.*
- b The cartilage framework is dissected from its bed, preserving the connective-tissue layer (B) over the frame. A galea-fascia-muscle flap (G) of adequate size is then outlined and raised on the mastoid.
- c A crescent-shaped cartilage graft (K) measuring approximately 35–40 mm x 10 mm x 12 mm (height) is inserted and sutured into place. The graft functions as a spacer to maintain the auriculocephalic angle.*

- d The cartilage graft is covered with the galea-fascia-muscle flap (G), which is secured with sutures and fibrin glue (Baxter, Heidelberg, Germany). The raw surface on the mastoid is reduced in size.*

- e Two split-thickness skin grafts (Sp) are glued and sutured into the defects. A tie-over Vaseline gauze bolster is secured with adhesive tape to create a light pressure dressing.

- f Sectional view of the individual layers

- I = Incision
- P = Limit of dissection
- Sp = Split-thickness skin graft
- G = Galea-fascia-muscle flap
- K = Cartilage graft
- B = Granulation and connective tissue

Generally the eighth rib is used to reconstruct the helix; it should be at least 8–10 cm long (see Fig. 11.3). Rib cartilage remnants are reimplanted subcutaneously in the thoracic wound for the second stage of the operation. The cartilage framework is inserted into the pocket (Fig. 10.30), and one or two continuous suction drains and bolster sutures coapt the skin to the frame. The bolster sutures are left in place for about 8 days (Fig. 10.30c). The suction drains are not removed before the sixth or seventh day.

Second stage (Brent 1992, Weerda 1996, Weerda et al. 1996; Fig. 10.31): About 8–12 weeks later a curved incision is made about 1–1.5 cm above and behind the rim of the implanted framework, and a thick split skin flap is sharply dissected to the rim on a shallow plane using a No. 15 blade (Fig. 10.31a, see Fig. 10.19 and pp. 33). The framework itself is not exposed, and care is taken to leave ample connective tissue on the back of the framework to ensure cartilage nutrition (Fig. 10.31b, B; see also Fig. 10.19).

A crescent-shaped cartilage graft 35–40 mm long, 10–12 mm high, and about 8 mm thick is carved from the rib cartilage that was banked in the thoracic pocket during the first operation (Fig. 10.31c). The cartilage graft is mobilized until it can be separated from the head by about 25 mm (distance from superior helical rim to mastoid) without tension (Fig. 10.31a–d). The crescent-shaped cartilage graft (K) is positioned under the new anthelix to function as a spacer (Fig. 10.31c) and is fixed to the anthelix with two sutures. An anteriorly based galea–fascia–muscle flap (G) is folded over the cartilage graft (Fig. 10.31b–d, f) and secured to the connective tissue with absorbable sutures and fibrin glue (Immuno, Vienna, Austria) (Fig. 10.31d, G). Perichondrium is left attached to the mastoid plane. The surrounding skin is mobilized and advanced behind the auricle. A Burow's triangle is excised, and the wound is closed in two layers (Fig. 10.31d). If there is adequate separation of the auricle from the mastoid (ideally about 2.0 cm to the upper helical rim), the remaining defects can be grafted with split-thickness skin from the groin or buttock (Fig. 10.31e, f). This graft is covered with a light pressure dressing (Fig. 10.31e), and the first ear bandage is not applied before day 6. The split-thickness skin graft can also be obtained from the head, keeping above the plane of the hair follicles in the scalp to permit rapid re-epithelialization and normal hair growth that will conceal the donor site. Additional touch-ups can be performed later. Figure 10.31f shows the individual layers in cross section.

Reconstruction of the Ear or Auricular Region in Patients with Skin Loss or Burns

(Fig. 10.32)

If the skin around the ear cannot be used, the parietotemporal fascia (Fig. 10.32) on the ipsilateral side can be transferred as a “fan flap” to cover the auricu-

lar framework. Split-thickness skin is then used to cover the fascia. The preferred donor site for this skin is the posterior surface of the opposite auricle, as this will provide the best color and texture match. The entire postauricular surface and mastoid area can be utilized while leaving the perichondrium on the auricle. A large split-thickness skin graft from the groin or buttock is then used to cover the postauricular surface and mastoid area on the normal side, and if necessary it can be used for the reconstructed postauricular surface as well. Split skin from the nearby scalp can also be used in a thickness of approximately 0.3 mm. If an ipsilateral parietotemporal fascial flap (Fig. 10.32) cannot be used due to an inadequate blood supply (evaluate by Doppler) or a severe burn, the surgeon may try to obtain a fan flap from the opposite side. This would require a free transfer and thus a surgical team trained and equipped to perform microvascular anastomosis. Another option is a forearm fascial flap with microvascular anastomosis.

Fan Flap of Parietotemporal Fascia

(Fig. 10.32)

The head is shaved on the designated side. A Doppler probe is used to locate and mark the course of the superficial temporal artery (Fig. 10.32a), and the skin over the fascia is opened with a zigzag incision (Fig. 10.32b). The skin should not be incised too deeply, because the parietotemporal fascia directly overlies the deep temporal fascia and is just below the hair bulbs and fat. The scalp is dissected to the left and right, directly below the plane of the hair bulbs. At this point the blood vessels can be clearly traced upward from the preauricular area. A fascial flap is outlined based on the size and shape of the auricular framework, which has already been fabricated. The flap is dissected from the deep temporal fascia and turned downward on its vascular pedicle (Fig. 10.32c). The cutaneous wound is closed in layers over a vacuum suction drain, and the auricular framework is covered with the fascia (Fig. 10.32d). Next a split-thickness or full-thickness skin graft is obtained and attached to the fascia with fibrin glue and a few interrupted sutures. The suction drain will coapt the fan flap to the auricular framework (Fig. 10.32d). A Vaseline pack is applied and secured with tape (for 1 week) to help shape and protect the reconstruction. Further touch-ups are added later as required (see second stage pp. 33; Fig. 10.31).

Transient flap edema is normal initially, but the flap should assume the desired shape and thickness over a period of weeks.

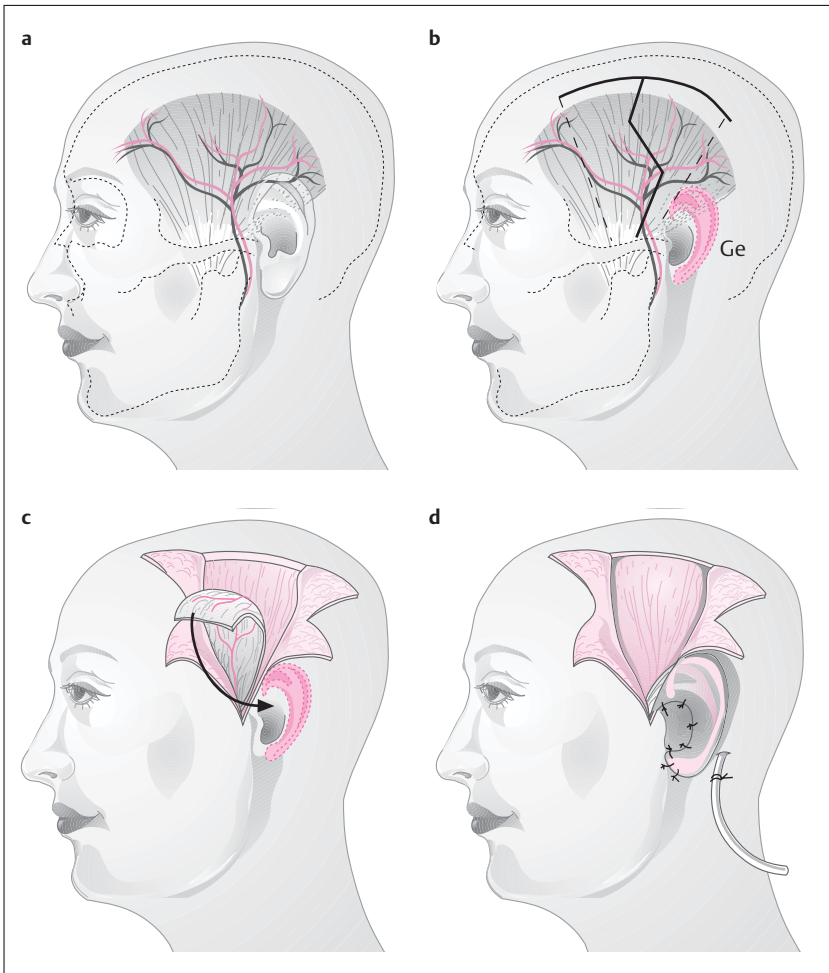


Fig. 10.32 Parietotemporal fascia transferred as a **fan flap**.

- a The superficial temporal artery and vein are identified (with Doppler ultrasound).
- b The parietotemporal fascia and blood vessels are exposed through a zigzag incision. (GE = cartilage framework)
- c The parietotemporal fascia is raised on a vascular pedicle.
- d The cartilage framework is covered with the vascularized fascia, followed by thick split skin (see text), and all wounds are closed.

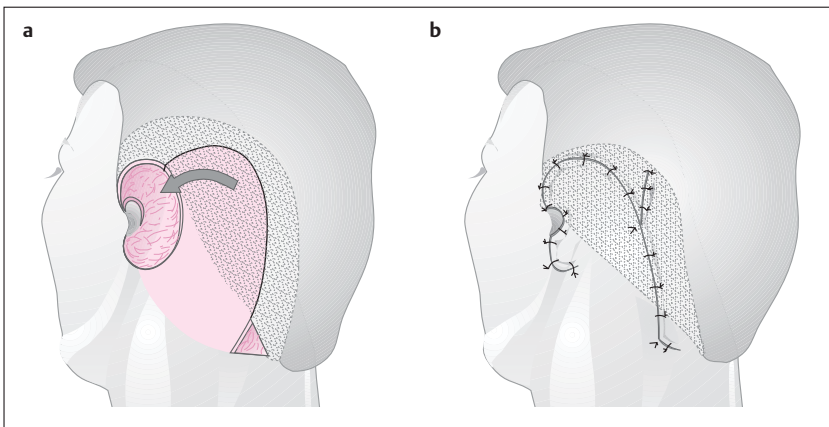


Fig. 10.33 a, b **Large defect in the auricular region** repaired with an inferiorly based rotation flap.

Closure of Defects in the Auricular Region (Figs. 10.33 and 10.34)

If an inferiorly or superiorly based transposition flap or rotation flap is not adequate, other options include a large inferiorly based rotation flap (Fig. 10.33),

bilobed flaps (similar to Fig. 10.28; Weerda 1978 a–c), or a bilobed flap (Fig. 10.34; see also Fig. 10.18). The second lobe of the bilobed flap is taken from the neck

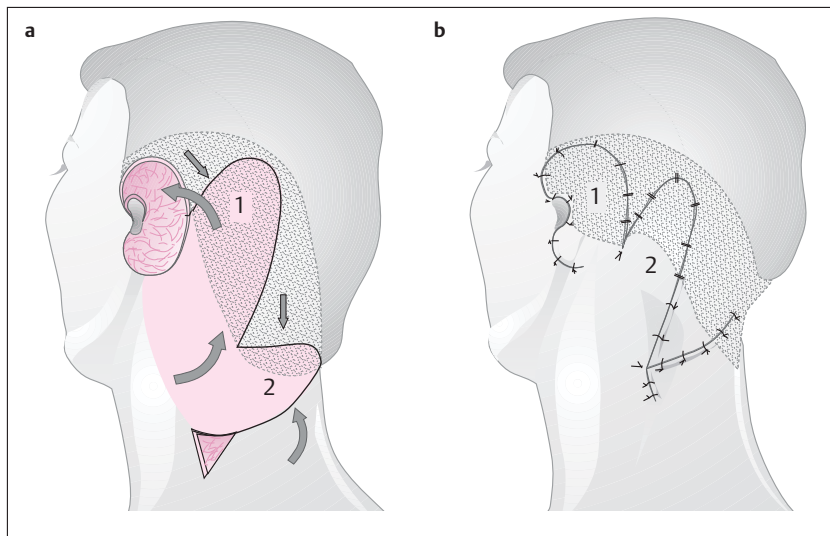


Fig. 10.34a, b Large defect in the auricular region repaired with a bilobed flap (Weerda 1978). The primary lobe is cut behind the defect, and the secondary lobe is outlined in the neck (across the nuchal hairline). The pivot point for this large rotation flap is located in the angle of the mandible.

(Weerda 1994). If these flaps are inadequate, myocutaneous island flaps (see Figs. 12.1 and 12.2) or free

flaps (see Fig. 14.1) can be used to repair large defects in this region.

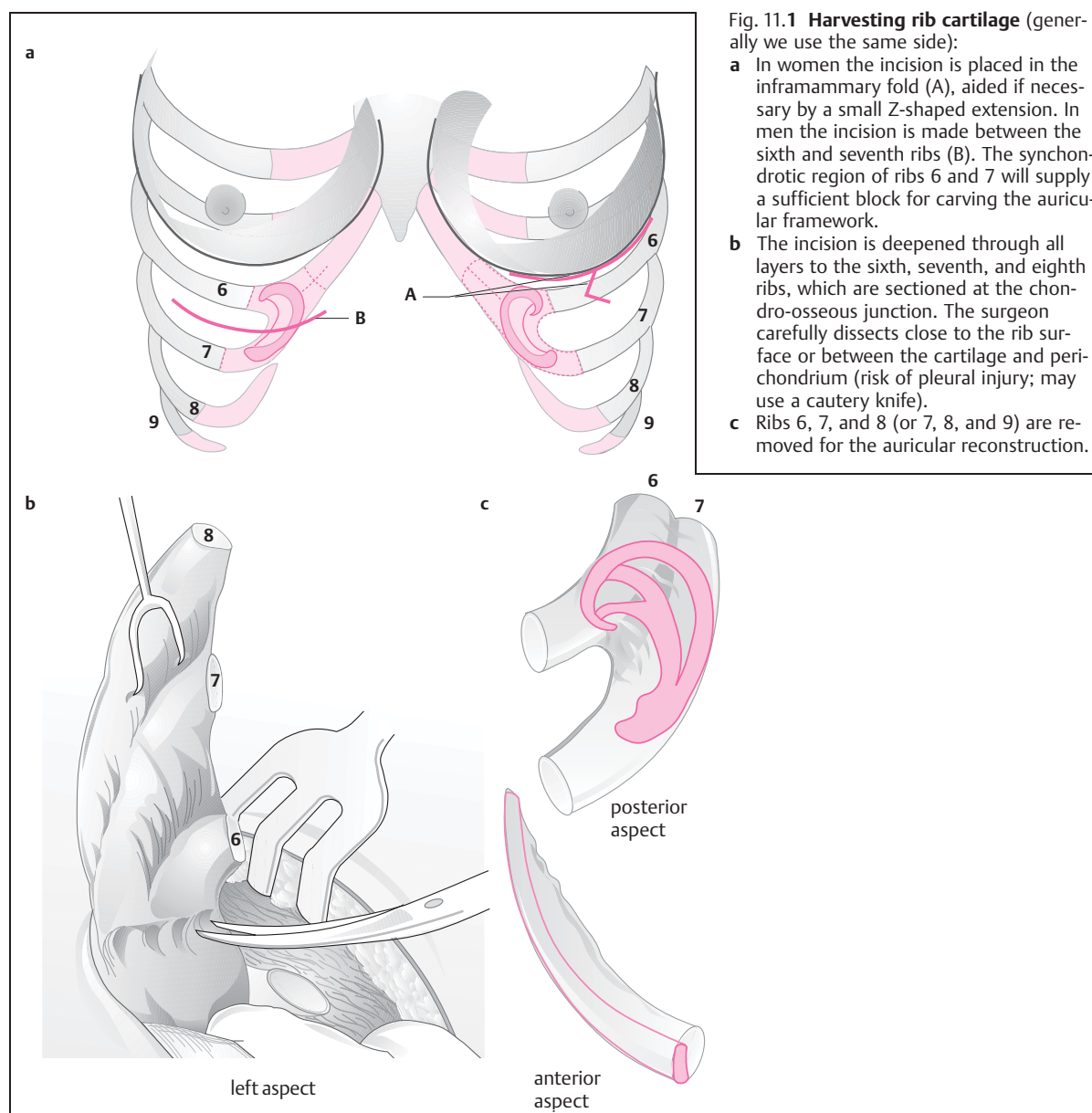
11 Rib Cartilage

Cartilage is a bradytrophic tissue (scant blood supply) and, as such, is excellent for reconstruction and augmentation of the trachea, nose, cheek, skin, and ear (Weerda 1985a).

Obtaining Rib Cartilage

(Fig. 11.1)

Rib cartilage is generally obtained from the same side of the thorax under general anesthesia. Small amounts of cartilage can be taken from the fourth,



fifth or sixth rib close to the sternum. We usually incise along the inframammary fold in women (Fig. 11.1a, A) and parallel to the donor site in men (Fig. 11.1a, B). The seventh rib is the longest cartilaginous rib and the last rib that extends to the sternum. The eighth rib is somewhat shorter and is often connected to the seventh rib by a synchondrosis. The sixth and seventh ribs generally supply a sufficient block to carve the body of the auricular framework (Figs. 11.1 and 11.3). The eighth rib can be used to make the helical rim if it is at least 8 cm long (preferably 9–10 cm).

Operative technique: We usually anesthetize the incision site with a local anesthetic solution containing epinephrine (diluted 1 : 200 000). The skin is incised parallel to the rib or over the costal arch (eighth rib), and all layers are divided down to the rib. Attention is given to the pleura, which should remain intact if at all possible. When whole cartilaginous ribs are removed, the muscle is cut close to the cartilage with an electrocautery or the perichondrium is dissected from the cartilage surface. If pleural injury occurs (under general anesthesia), a small piece of fascia (free or pedicled) should be glued over the defect and the wound closed over a suction drain while ventilation is maintained. With a small wound in the parietal pleura and an airtight layered closure, there should be no further difficulties. The fascial and subcutaneous layers should be closed separately. We generally use 4–0 (or 3–0) intracutaneous monofilament sutures for skin closure (see Fig. 2.5).

Preparation of Cartilage Grafts

(Fig. 11.2)

Some types of cartilage graft, such as nasal onlay grafts, can warp after implantation. This has led to the use of “balanced” grafts as suggested by Gibson and Davis (1958) (Fig. 11.2). The graft should be cut

from the center of the cartilage to minimize its warping tendency (Fig. 11.2a). Various techniques of graft preparation are illustrated in the figure. Cartilage segments with different warping tendencies can be assembled to produce a more stable graft (Fig. 11.2c). Generally the perichondrium is removed or at least scored, since the graft tends to warp in the direction of the perichondrium.

Carving an Auricular Framework

(Fig. 11.3)

The framework should be as delicate as possible and about 3 mm smaller than the film pattern in all dimensions (see Fig. 10.13). The block from which the main framework is carved may be obtained from the ipsilateral side (Weerda, Nagata: operative side, easier access) or from the contralateral side (Brent, Siebert) (Fig. 11.3a, b; see also Fig. 11.1).

Instruments: The instruments for framework fabrication consist of No. 11 and No. 15 scalpel blades, special sharp gouges (see Fig. 2.7a, 7) 2–5 mm in width, 5–0 wire suture material, and 5–0 braided absorbable sutures (e.g., Vicryl [Ethicon, Germany]) on a P3 (Ethicon, Germany) needle. The framework is carved 3 mm smaller than the pattern. In most cases, all of the main framework can be fabricated from the sixth and seventh ribs (Fig. 11.3a–c), otherwise it must be assembled from smaller segments. The helical rim is carved separately from the eighth (or ninth) rib, which should be at least 8–9 cm long (Fig. 11.3d). The rim should be 8–10 mm wide and is affixed to the main framework with doubly armed wire or absorbable suture material (4–0 or 5–0 on straight needles) (Fig. 11.3e).

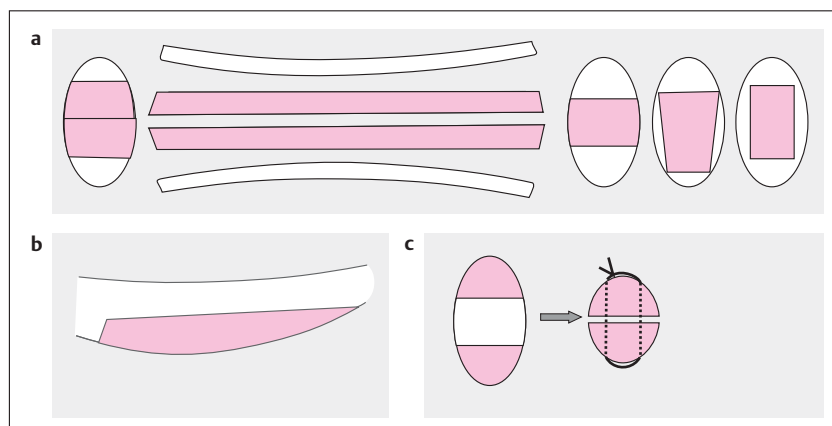


Fig. 11.2 “Balanced” cartilage grafts designed by Gibson and Davis (1957).

- a Grafts of various shapes cut from the center of a rib.
- b Nasal dorsal onlay graft from the ninth rib.
- c Graft shape can be stabilized by sewing together two pieces of cartilage that have opposite warping tendencies.

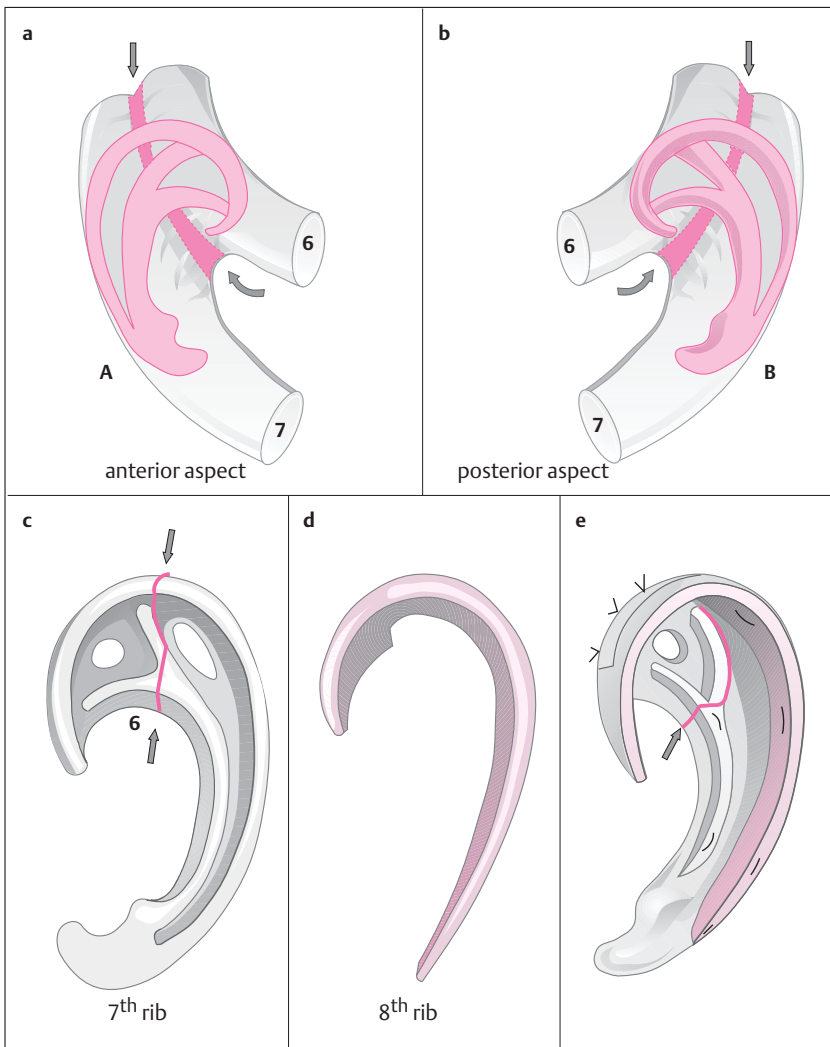


Fig. 11.3 Fabricating a **cartilage framework for total auricular reconstruction** (generally left side thorax for a left auricle).

a, b The pattern is placed on the exposed cartilage: A, the **posterior side** of the cartilage for an **ipsilateral** reconstruction (A); the **anterior side** for a **contralateral** reconstruction (B; see Fig. 11.1). Synchondrosis between the sixth and seventh ribs (arrow).

c The main framework for a left ear (about 3 mm smaller than the proposed auricle). Arrow: synchondrosis.

d Helical rim carved normally from the eighth (or ninth) rib, 9–10 cm long.

e The helical rim is attached to the main framework with 5–0 wire sutures and/or 4–0 Vicryl (Ethicon, Germany) sutures (doubly armed, straight needles). Arrow: synchondrosis.

12 Myocutaneous Island Flaps

S. Remmert, K. Sommer

Pectoralis Major Island Flap

(Fig. 12.1)

Flap type: myocutaneous island flap of the axial pattern type (see Figs. 1.3 and 1.4).

Flap components: skin, subcutaneous fat, fascia, muscle (pectoralis major).

Use: myocutaneous island flap for reconstructing major defects in the neck and face (microvascular free transfer is possible).

Vascular pedicle: The skin and muscle are supplied by the thoracoacromial artery, which is the second branch of the axillary artery past the scalene interval. The flap is supplied by the pectoral branches of the artery and their venae comitantes.

Position: supine.

Flap size: maximum 10 x 20 cm.

Flap elevation: An imaginary line from the acromion of the scapula to the xiphoid process of the sternum marks the axis of the nutrient pectoral branches (Fig. 12.1, 3). The pivot point of the pectoralis major island flap is located just below the middle third of the clavicle. The pedicle must be long enough to reach from the pivot point at the

clavicle to the recipient site in the head and neck region (Fig. 12.1, 7). The skin paddle should be placed medial to the nipple whenever possible. The incision is carried across the thorax (Fig. 12.1, 4), the skin is undermined to the lower incision for the subsequent transfer (Fig. 12.1, 4), and the skin, muscle, and underlying fascia are incised to outline the flap (Fig. 12.1, 6). The muscular portion of the flap should be slightly larger than the skin paddle. Next the skin is sutured to the subcutaneous fat on the muscular fascia to prevent shearing of the myocutaneous perforators. Proceeding from below upward, the pectoralis major muscle is elevated from the chest wall on its nutrient vascular pedicle along with the deep muscular fascia. The arc of rotation can be increased by releasing the humeral and clavicular muscle attachments, leaving about a 4-cm-wide muscle pedicle to protect the nutrient vessels. The **skin outline of a deltopectoral flap should be preserved** (Fig. 12.1, 5) so that this flap will also be available if needed. When the island flap has been elevated to the clavicle, it is rotated 180° and carefully tunneled under the skin and over the clavicle to reach the defect (Fig. 12.1, 7).

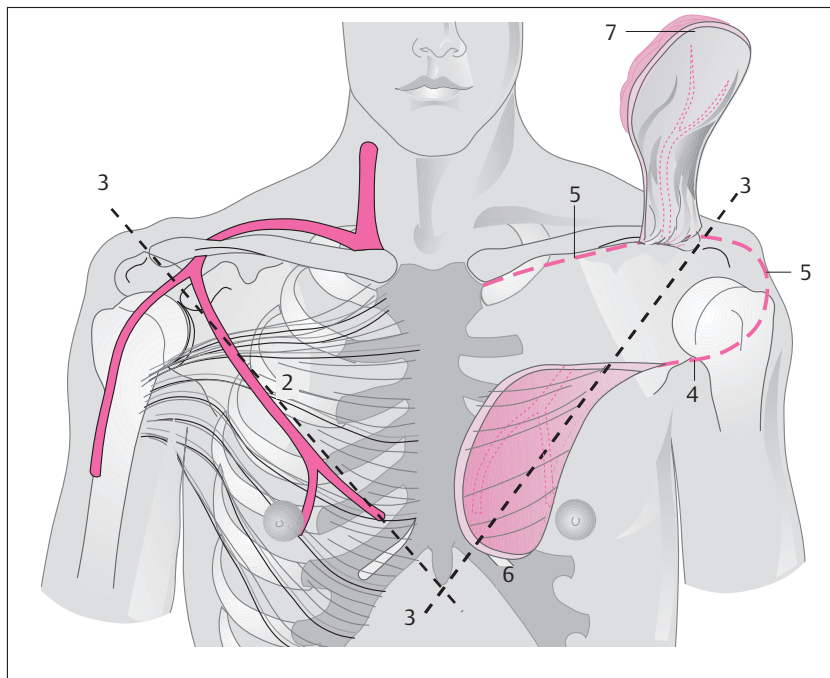


Fig. 12.1 Myocutaneous pectoralis major island flap.

- 1 Axillary artery
- 2 Thoracoacromial artery
- 3 Ariyan's line
- 4 Incision for raising the flap
- 5 Incision for a deltopectoral flap
- 6 Incision outlining the myocutaneous flap
- 7 Length of the flap

Indications and advantages: The pectoralis major island flap can be used in reconstructions of the pharynx, tongue, face, neck, and especially to cover the carotid artery when this vessel is at risk due to prior irradiation. Tumor excision and reconstruction can be completed in one operation. We find that the vascular pedicle has a consistent anatomic course. Direct closure is possible in most patients. There is no need to reposition the patient when raising the flap. The pectoralis major flap can be combined with a deltopectoral flap (Fig. 12.1, 5) or a latissimus dorsi island flap (see Fig. 12.2). It can also be used as a purely muscular flap or myofascial flap without a skin paddle.

Disadvantages and complications: A large donor defect will require skin grafting. Esthetic objections are most common in women due to breast distortion, and the incision should be placed in the inframammary fold whenever possible. Thick subcutaneous fat and muscle bulk make it difficult to model the flap. Long-term results can be marred by volume reduction due to shrinkage and scarification. Heavy body hair in male patients limits the indications for this flap in reconstructions of the oral cavity and pharynx.

Latissimus Dorsi Island Flap

(Fig. 12.2)

Flap type: myocutaneous island flap of the axial pattern type (see Figs. 1.3 and 1.4).

Flap components: skin, subcutaneous fat, fascia, muscle (latissimus dorsi).

Use: myocutaneous island flap, microvascular anastomosis.

Vascular pedicle: The vascular bundle supplying the muscle consists of the thoracodorsal artery and vein (Fig. 12.2), which are a continuation of the subscapular artery and vein and give off the circumflex scapular artery and vein about 2–4 cm below their origin from the axillary artery and vein (Fig. 12.2). Several millimeters below the origin of the circumflex scapular artery, a vessel springs from the thoracodorsal artery to supply the serratus anterior muscle. The caliber of the vessel increases toward the axillary artery and is approximately 2–4 mm at its origin. The vascular pedicle is approximately 10–15 cm long. The venae comitantes are often paired but have a common termination in the axillary vein.

Flap size: The latissimus dorsi flap is the largest myocutaneous flap used in plastic reconstructive surgery. It has a maximum useful size of 20 x 35 cm (“tennis racket” flap; Fig. 12.2, 6).

Position: lateral decubitus.

Flap elevation: A line is drawn (Fig. 12.2, 5) from the center of the iliac crest to the posterior axillary line. The vascular bundle enters the muscle on that line about 10–12 cm below the axilla, and this point is

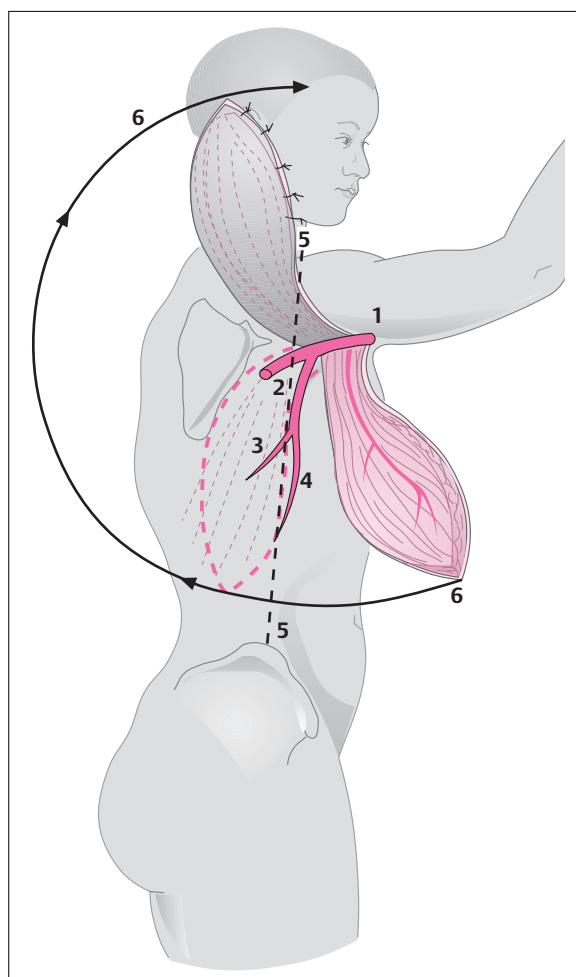


Fig. 12.2 Myocutaneous latissimus dorsi island flap.

- 1 Axillary artery
- 2 Subscapular artery
- 3 Circumflex scapular artery
- 4 Thoracodorsal artery

The flap is raised behind a line from the center of the iliac crest to the anterior axillary fold (5). The flap is based on the thoracodorsal artery (4). The initial incision is made over the anterior border of the latissimus dorsi muscle, following the line shown (5). The very large flap has a long arc of rotation (6) that can reach all head and neck defects (see text).

marked on the skin. The connecting line runs about 2 cm behind the anterior border of the latissimus dorsi muscle and also represents the rotational axis of the flap. The skin paddle should be designed over the anterior border of the muscle, as this area has the greatest density of perforator vessels. The initial incision is made along the line to the level of the proposed flap, and the anterior border of the latissimus dorsi is exposed. The vascular pedicle is identified medial to the anterior border and traced to the site where it enters the muscle. The vascular pedicle is dissected superiorly to its origin from the maxillary artery. The perimeter of the skin paddle is incised,

and the latissimus dorsi muscle is bluntly separated from the serratus anterior muscle from the anterior side, using some sharp dissection inferiorly. The skin is sutured to the subcutaneous fat on the muscle to prevent shearing of the perforator vessels. A myocutaneous island flap is created by rotating the tissue 180° on the myovascular pedicle at the level of the axillary artery (Fig. 12.2, 6). The flap is carefully passed through a prepared subcutaneous tunnel to its destination and sutured into place. If the flap cannot reach the defect, it can be transferred as a microvascular free flap.

Indications and advantages:

- Long vascular pedicle can reach any site in the head and neck region.
- Constant, large-caliber vascular pedicle.
- Largest flap in reconstructive surgery.
- In most cases the donor site can be closed primarily with an acceptable cosmetic result.
- We have seen no significant functional deficits at the donor site, and the flap can be used in conjunction with other flaps.
- The peripheral vascular pattern allows multiple flaps to be based on one pedicle.
- We have had no breast mutilation.

Disadvantages and complications:

- The patient must be repositioned during the operation.
- When a very large flap is raised, the donor site requires partial coverage with split skin grafts.
- The large wound area often leads to seroma formation.
- The transferred tissue tends to shrink and scarify over time.

Neurovascular Infrahyoid Myofascial Flap of Remmert (1994)

(Fig. 12.3)

Flap type: neurovascular myofascial flap of the axial pattern type (see Figs. 1.3 and 1.4).

Flap components: muscle (infrahyoid muscle group), fascia.

Use: as a neurovascular myofascial island flap or microvascular free flap with a neural pedicle (Fig. 12.3a, b).

Vascular pedicle: The superior thyroid artery (Fig. 12.3a, b, 4) usually arises from the external carotid artery but may also arise from the bifurcation of the common carotid artery. The thyroid vein drains chiefly into the facial vein and internal jugular vein. A segmental drainage pattern exists in 20% of cases. The dissected vascular pedicle is 2 cm long with an arterial caliber of 1.5 mm and a venous diameter of 2 mm. The superior root of the deep ansa cervicalis, which supplies motor innervation to the infrahyoid muscles, is found just lateral and superior to the posterior cornu of the hyoid bone (Fig. 12.3c).

Flap size: up to 3.5 x 11.5 cm.

Position: supine.

Flap elevation: The infrahyoid muscle group is reached through the approach for a standard neck dissection. The superior root of the ansa cervicalis is identified above and lateral to the posterior cornu of the hyoid bone (Fig. 12.3c) and must be preserved along with the superior thyroid artery and vein (Fig. 12.3b). The musculature is divided cranial to the hyoid bone and along the linea alba, whereupon the flap is elevated from the larynx and thyroid gland in a medial to lateral direction. The thyrohyoid muscle should be left in place to protect the superior vascular bundles of the larynx. The rest of the dissection proceeds from below upward along the large vessels, including the ansa cervicalis of the hypoglossal nerve in the dissection. Based only on the neurovascular bundle, the flap can now be rotated into the area of the defect.

Indications and advantages:

- The flap is particularly useful for reconstructing the tongue and pharynx, since it can actively contract owing to voluntary innervation from the superior root of the ansa cervicalis.
- The flap can be exposed through a standard neck dissection with no additional scars or cutaneous defects.
- Voluntary innervation via the ansa cervicalis tends to reduce shrinkage and scarring of the muscle tissue.
- The myofascial flap is relatively thin and pliable (Remmert et al. 1994, 1995, 1998).

Disadvantages and complications:

- The flap cannot be used in patients with extensive cervical metastasis.
- If the vascular pedicle has a low origin, the arc of rotation will be insufficient to reach the oral cavity, necessitating microsurgical transplantation and elongation.

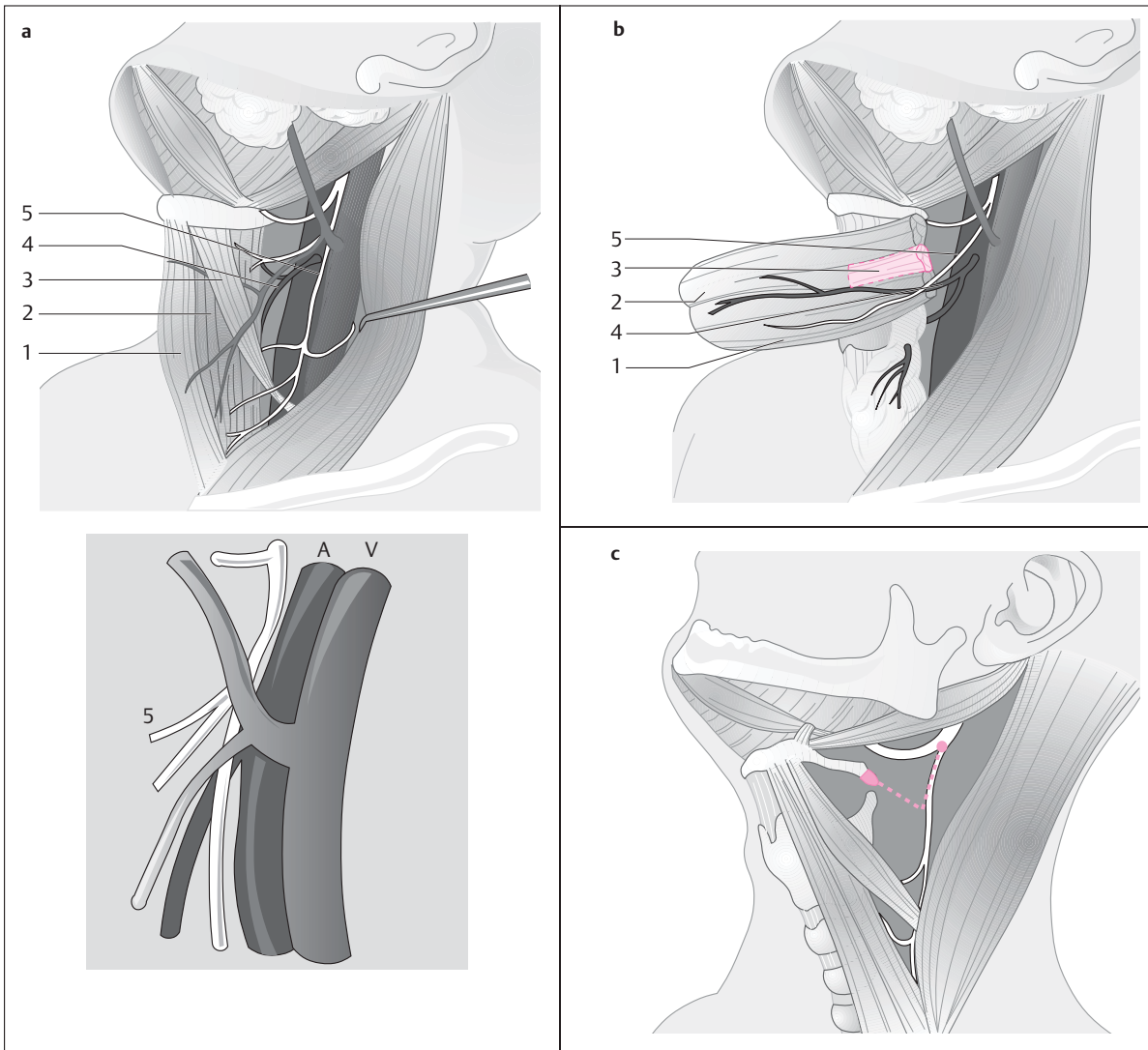


Fig. 12.3 **Neurovascular infrahyoid myofascial flap** of Remmert (1994).

a The infrahyoid muscles (1, 2, 3) are based on the superior thyroid artery and vein (4) and on the superior root of the ansa cervicalis (5).

b The myofascial flap is divided, and the nutrient vessels (4) and ansa cervicalis (5) are dissected.

c Junction of the hypoglossal nerve and the superior root of the deep ansa cervicalis, located 1 cm above and lateral to the posterior crus of the hyoid bone.

13 Deltopectoral Flap

S. Remmert, K. Sommer

Although this flap (see Fig. 12.1, 5) is credited to Bakamjian, it was first mentioned in the German literature during the 1900s and in the American literature in the early 2000s. Once commonly used, the deltopectoral flap has now been largely superseded by the pectoralis major island flap.

Flap type: fasciocutaneous flap of the random pattern type (see Fig. 1.2).

Flap components: skin, subcutaneous fat, muscular fascia.

Use: as a regional transposition flap.

Vascular supply: First through fourth perforating branches of the internal thoracic artery (internal mammary artery).

Position: supine.

Flap size: Width 8–12 cm, length 18–22 cm (the flap can be extended to the shoulder).

Flap elevation: The flap is designed larger than the size of the ablative defect. When the flap is raised, the fascial layers of the pectoralis major and deltoid muscles should be taken with the flap because they transmit the perforating branches. Care is taken not to kink the flap or rotate it excessively when suturing it into the defect. As much of the donor defect as possible is closed directly, and the rest is split-skin grafted. No pressure should be placed on the flap

during the first few postoperative days, and the chest, shoulder, and neck should be immobilized. Adequate wound drainage should also be maintained, and any hematomas under the flap should be evacuated without delay.

Indications and advantages:

- The deltopectoral flap is most commonly transferred upward to close postirradiation fistulas and resurface large cutaneous defects in the neck, especially in cases where the myocutaneous pectoralis major island flap is no longer available.
- Vascular supply is constant.
- The flap is easy to expose and dissect.
- The flap provides approximately 250 cm² of skin.
- The flap has an arc of approximately 45–135°.

Disadvantages and complications:

- When a large flap is raised, split-skin grafting of the donor site is required.
- Unfavorable cosmetic result due to exposed scars.
- The flap has a significantly lower survival rate in patients who are emaciated, have undergone radiation therapy, or have severe cardiovascular problems. In these cases the transfer should be preceded by a delay.

14 Free Flaps

S. Remmert, K. Sommer, H. Weerda

Radial Forearm Flap

(Fig. 14.1)

Flap type: fasciocutaneous (neurovascular) flap or pure fascial flap of the axial pattern type (see Figs. 1.3 and 1.4).

Flap components: skin, subcutaneous fat, and fascia (may include sensory nerve).

Use: microvascular flap.

Vascular pedicle: The flap is based on the radial artery, which is a continuation of the brachial artery. Its caliber is approximately 1–2 mm. The radial artery is accompanied in its distal portion by two venae comitantes (Fig. 14.1, 2), which unite at the elbow to form one vein about 2 mm in diameter. The flap is innervated by the lateral antebrachial cutaneous nerve (Fig. 14.1, 9), which runs parallel to the superficial cephalic vein.

Flap size: maximum 5 x 15 cm.

Position: supine.

Flap elevation: Before the operation, it is determined whether the hand will survive without radial arterial input. This is done by performing an Allen test (see p. 33) or using Doppler ultrasound or angiography to check for adequate collateral flow via the ulnar artery. The flap size is marked on the skin, and an S-shaped incision is made from the elbow to the proximal margin of the flap, dividing the forearm fascia. Next the muscle bellies of flexor carpi radialis and brachioradialis are identified (Fig. 14.1, 4 and 5) and separated from their intermuscular septum. The radial artery and its two venae comitantes lie between these muscle bellies on the fascia of flexor digitorum superficialis. Next the perimeter of the flap is incised, dividing the fascia of flexor digitorum superficialis at the ulnar border. The dissection of the

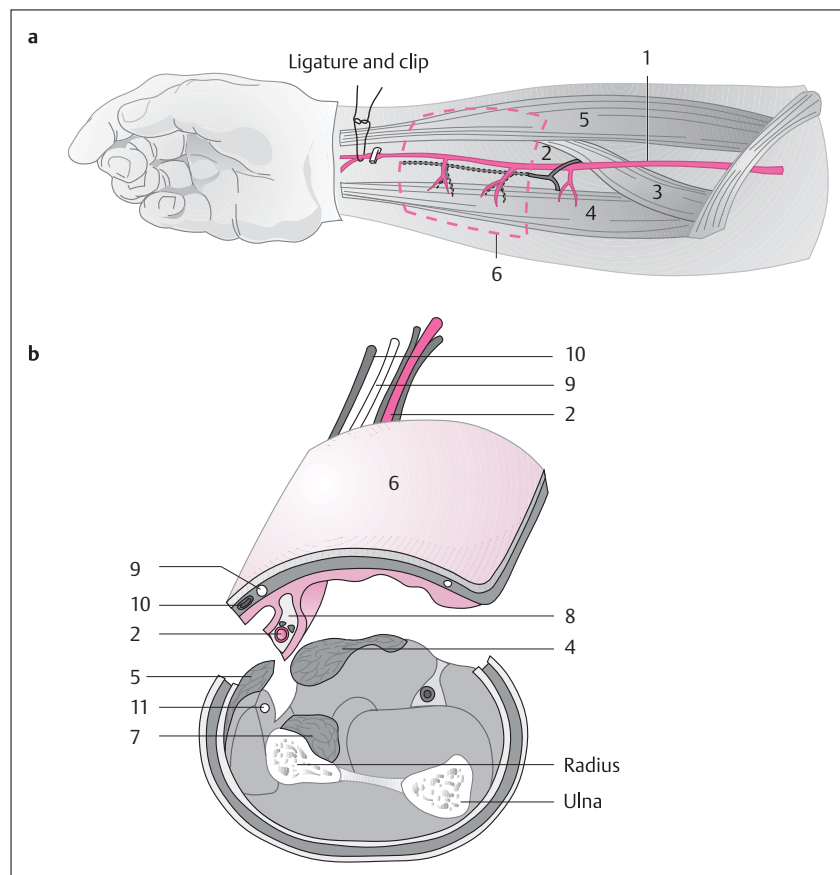


Fig. 14.1

a Design of the **radial forearm flap**, a free flap based on the radial artery and two venae comitantes (2) (see text).

- 1 Brachial artery
- 2 Radial artery
- 3 Pronator teres muscle
- 4 Flexor carpi radialis muscle
- 5 Brachioradialis muscle
- 6 Flap
- 7 Flexor pollicis longus muscle
- 8 Deep fascia
- 9 Lateral antebrachial cutaneous nerve
- 10 Cephalic vein
- 11 Radial nerve

b Cross section of the forearm (viewed from above; from Walter 1997).

flap and muscular fascia (Fig. 14.1, 8) proceeds from the ulnar to the radial side, avoiding injury to the peritendinous tissue. The flap should not be developed too far distally to preserve the extensor retinaculum. Next the radial artery and its accompanying veins are ligated at the distal margin of the flap. The next step is to dissect the fasciocutaneous tissue from the radial side as far as the abductor pollicis longus and brachioradialis muscles, preserving the superficial branch of the radial nerve. The vascular pedicle is raised with the fascia of flexor digitorum superficialis in a distal to proximal direction, and finally the radial artery and venae comitantes (or one deep vein draining into the accompanying veins) are ligated. The donor site is closed by a combination of direct closure and split-skin grafting (Remmert 1995).

Indications and advantages:

- The radial forearm flap is very good for reconstructions of the oral cavity, tongue, pharynx, and neck.
- The vascular pedicle has a consistent length.
- The flap is pliable.
- There is no need to reposition the patient intraoperatively.
- Tumor resection and reconstruction can be performed in one operation.
- Two teams can work concurrently: one removes the tumor while the other harvests the flap.
- When a radial forearm flap is used for tongue reconstruction, for example, sensation is restored by anastomosing the lateral antebrachial cutaneous nerve to the lingual nerve.

Disadvantages and complications:

- The donor forearm must be immobilized for 10 days.
- Split-skin grafting of the defect may lead to wound healing problems in the flexor tendon area and cosmetic morbidity.
- The flap may shrink by up to 25%.

Allen Test

The Allen test is used to determine whether the ulnar artery will adequately supply the hand following radial artery ligation. The patient is told to make a tight fist with the affected hand. Then the examiner simultaneously compresses the radial artery and ulnar artery, the patient slowly opens the hand, and pressure on the ulnar artery is released. In an abnormal test the fingers do not show significant capillary fill (blush) within 5 seconds after ulnar artery release, and a radial forearm flap is contraindicated. A similar test is used intraoperatively. Following the usual dissection of the radial forearm flap and exposure of the axial vascular bundle, the radial artery is

clipped at the distal margin of the flap. If oxygen saturation measured on the thumb does not fall below 97%, it is assumed that the ulnar artery is providing an adequate collateral supply, and the radial forearm flap can be raised (Remmert and Sommer 1993).

Groin Flap

(Fig. 14.2)

Flap type: osteomyocutaneous flap (composite or compound) of the axial pattern type.

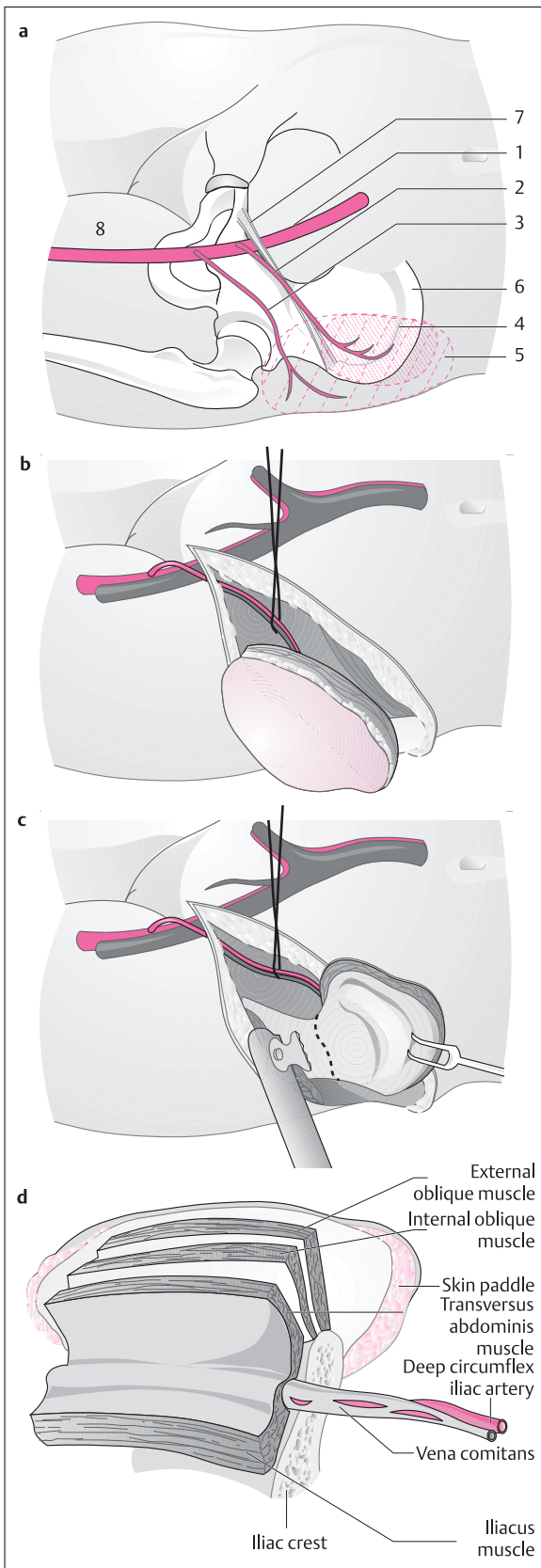
Flap components: skin, subcutaneous, muscle (internal oblique), bone (ilium). The groin flap can be transferred as a bone graft only (iliac crest bone graft), as a bone graft with muscle, or as a bone graft with muscle and skin (osteomyocutaneous flap).

Use: microvascular transfer.

Vascular pedicle: The osteomyocutaneous flap is supplied by the superficial and deep circumflex iliac arteries. The deep circumflex iliac artery is the more important of the two, arising from the external iliac artery posterior to the inguinal ligament (Fig. 14.2, 1). Its vascular pedicle has a length of 80–120 mm and a caliber of 3 mm and chiefly supplies the ilium. In 75% of cases there is an ascending branch with perforators, which supplies the internal oblique muscle along with a 2.5 x 8-cm skin area over the iliac crest (Fig. 14.2, 4). The superficial circumflex iliac artery (Fig. 14.2, 3) arises from the femoral artery 30 mm below the inguinal ligament. Its vascular pedicle has a length of 5–20 mm and a caliber of 1.5 mm. The vessel mainly supplies a 12 x 23-cm skin area over the iliac crest (Fig. 14.2, 5). If only a small skin paddle is required, the deep circumflex iliac artery (Fig. 14.2, 2) is the only vessel that needs to be anastomosed at the recipient site. If a larger skin paddle is needed, the superficial circumflex iliac artery (Fig. 14.2, 3) should also be anastomosed (Remmert et al. 1998).

Position: supine.

Flap elevation: First the inguinal ligament, femoral artery, and iliac crest are marked out on the skin (Fig. 14.2, 6 and 7). The skin paddle is outlined and its perimeter incised, dividing the skin and subcutaneous tissue down to the abdominal wall musculature. When the skin paddle is raised from the external oblique muscle, an area of muscle about 3 x 8 cm is left on the upper iliac crest. The muscle and skin in this area should not be divided to preserve the perforator vessels to the skin paddle. After the external oblique muscle has been divided, leaving a flap about 2–4 cm wide on the iliac crest, an adjacent internal oblique muscle flap based on the iliac crest is cut to match the size of the defect. The underlying transversus abdominis muscle is divided like the external oblique, leaving a strip of muscle about 2–4 cm wide on the iliac crest. This muscular cuff transmits the deep circumflex iliac artery (Fig. 14.2, 2) with its per-



◀ Fig. 14.2

- a** The **groin flap** can be designed as a myocutaneous or osteomyocutaneous transfer (compound flap, see text).
- 1 External iliac artery
 - 2 Deep circumflex iliac artery
 - 3 Superficial circumflex iliac artery
 - 4 Size of the skin area supplied by the deep circumflex iliac artery
 - 5 Size of the skin area supplied by the superficial circumflex iliac artery
 - 6 Iliac crest
 - 7 Inguinal ligament
 - 8 Femoral artery
- b** The skin paddle and muscle are elevated on the deep circumflex iliac artery and its venae comitantes (after Bootz 1992).
- c** The iliacus muscle is detached medially, the tensor fasciae latae and gluteus medius laterally, and the sartorius anteriorly. The bone fragment (outlined from a pattern) is removed with a saw.
- d** The composite (compound) iliac crest flap has been harvested with its skin paddle (viewed from the medial side).

forators. After the tensor fasciae latae and gluteus medius are separated from the lateral aspect of the ilium, the vascular pedicle is exposed by detaching all abdominal wall layers at the level of the anterior superior iliac spine. The deep circumflex iliac artery arises from the external iliac artery posterior to the inguinal ligament. The vascular pedicle is dissected free, proceeding in a medial to lateral direction as far as the anterior superior iliac spine. Finally the iliacus muscle is released from the medial surface of the ilium, fully exposing both the medial and lateral aspects of the bone. A bone fragment of the necessary size and shape (determined from a pattern) is cut from the ilium with an oscillating saw, the vascular pedicle is divided, and the osteomyocutaneous flap is transferred to the recipient site. The donor site is carefully closed in layers to prevent hernia formation (Remmert et al. 1998).

Indications and advantages:

- This flap is used for reconstructions of the mandible, maxilla, cheek, and occasionally the forehead.
- Consistent vascular anatomy.
- Skin, muscle, and bone can all be reconstructed with one flap.
- Bone from the iliac crest provides a good bed for dental implants.
- Tumor resection and reconstruction can be performed in one operation.
- There is no need to reposition the patient intraoperatively.

Disadvantages and complications:

- Risk of hernia formation.
- With a large skin paddle, both the deep and superficial circumflex iliac arteries must be anastomosed at the recipient site.
- Primary closure of the donor site is not possible when a large skin paddle is taken.
- Severe pain may occur.

Microvascular Surgery**Instrumentation**

(Fig. 14.3)

The instruments required for microvascular surgery are relatively few in number: straight and curved microforceps (Fig. 14.3a), microscissors (Fig. 14.3b), and

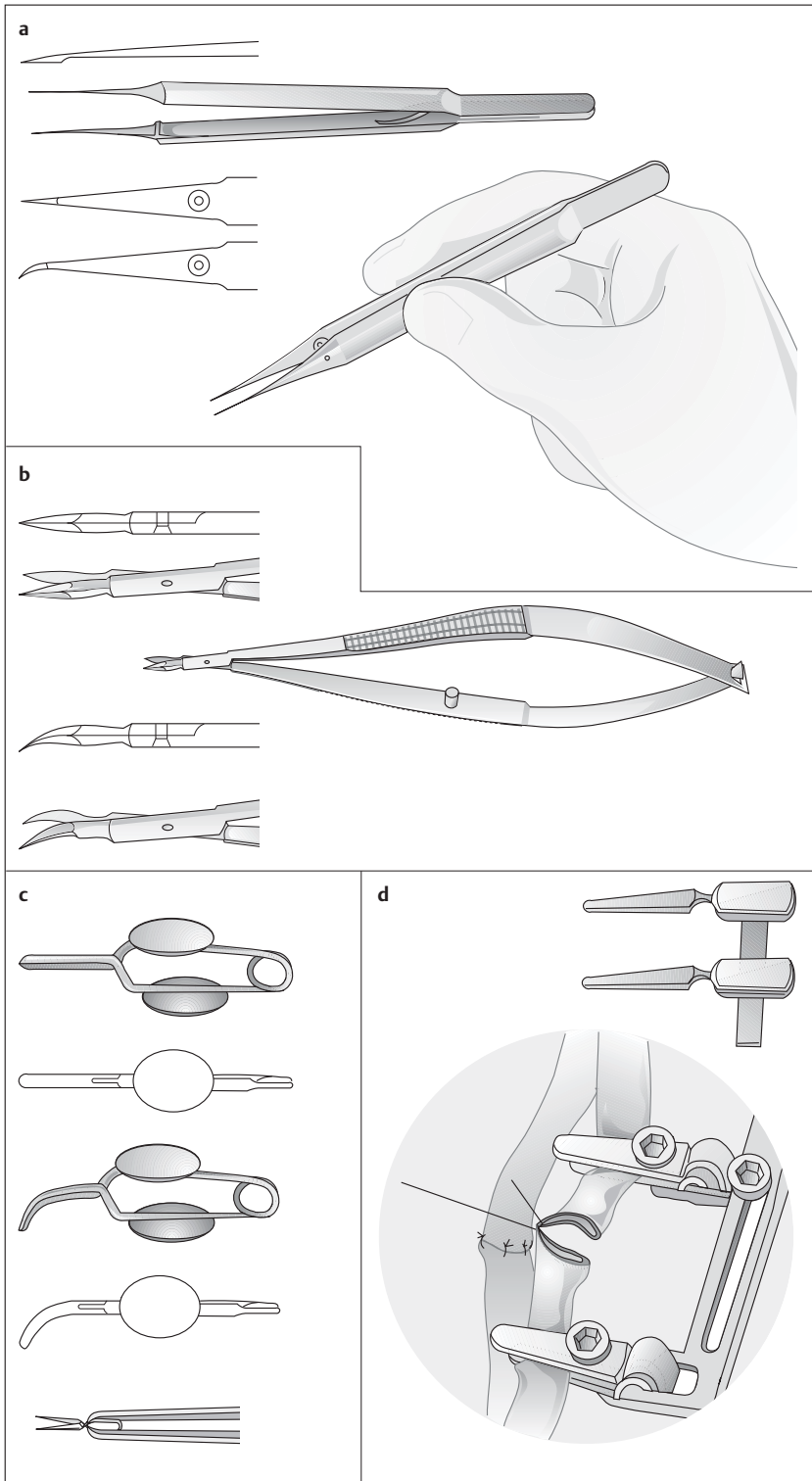


Fig. 14.3 Instruments for **microvascular surgery**.

a Straight and curved microforceps.

b Spring-handled microscissors, straight and curved (also: spring-handled needle holder with fine jaws).

c Vascular clips and clip applicator.

d Approximators (double micro-clamps).

vascular clips and clip applicators (Fig. 14.3c). Microforceps or special spring-handled needle holders are excellent for suturing. Round-handled instruments are advantageous, as they can be rotated between the fingers and supported on the metacarpus. Vascular clips are needed to occlude the blood flow and keep the vessel ends from retracting into the soft tissues. Approximators (Fig. 14.3d) make it easier to hold the vessels in position and rotate them as needed to access the back wall. This special instrument set for microvascular suturing is complemented by various syringes, cotton swabs, and the suture material itself. Syringes are used to flush out the vessel ends with heparinized sodium chloride solution and to irrigate the vessels with lidocaine. Cotton swabs are used to soak up blood and irrigation fluid and for hemostasis. The suture material of choice is monofilament Ethilon. Monofilament material does not have the wick action of multifilament material and does not cause tissue friction. Suture size is determined by the diameter of the vessels to be anastomosed. Sizes 9-0 and 10-0 are recommended for vessel diameters of approximately 1 mm and 8-0 for diameters of 2–3 mm. We generally use 3/8 round-body needles such as MV-10, BV-4, and BV-2¹.

Practicing for Microvascular Surgery

Cobbett coined the term “microvessel” for very small vessels that have an outer diameter of 3 mm or less. As the vessel diameter becomes smaller, there is greater potential for errors and complications associated with microvascular manipulations. For example, while 1 or 2 mm of narrowing in a large vessel like the femoral artery has virtually no functional significance, even a tiny reduction in cross section can have major consequences when it occurs at the microvascular level. For this reason, microvascular anastomosis is a technically challenging procedure

that requires a high degree of manual dexterity. In addition, a knowledge of coagulation processes, hemodynamics, the micromorphology of small vessels, and the terminal vascular branches in various tissues is essential for successful microvascular suturing and for the survival of transplanted or replanted tissues. These essential skills and knowledge are acquired only through experimental practice and study. A good way to learn microvascular suturing technique is through a staged approach that starts with practice on experimental animals. White male rats with a body weight of 250–350 g are optimal. They have less fatty tissue than females, and the vessel diameters are larger.

Knot-Tying Practice Under a Microscope or Binocular Loupe (Figs. 14.4–14.7)

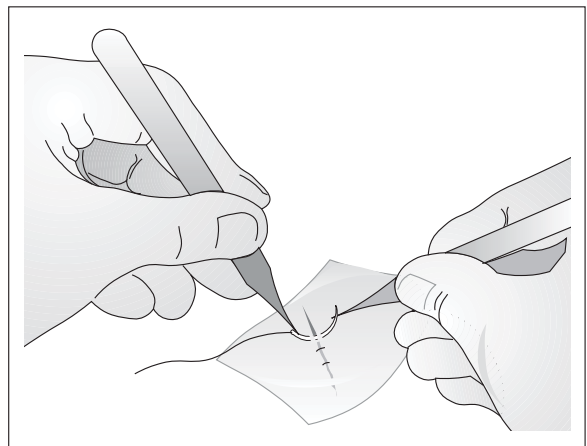


Fig. 14.4 **Knot tying** for microvascular anastomoses can be practiced on thin silicone film or surgical glove material.

¹ Ethicon

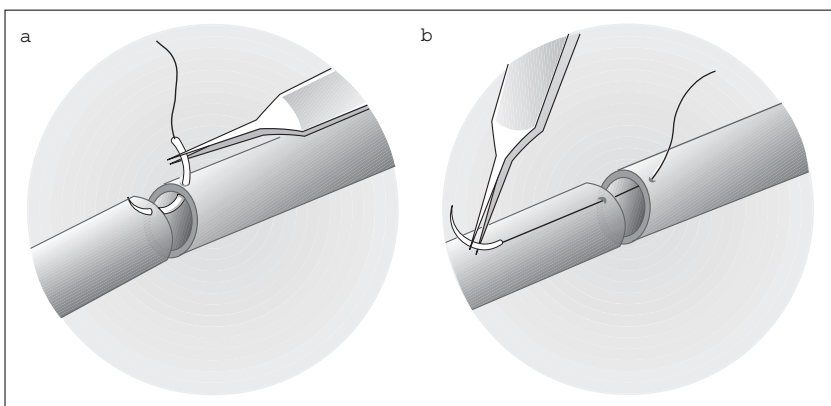


Fig. 14.5

- a End-to-end anastomosis,** practiced in a thin silicone tube. The needle should enter and exit perpendicular to the vessel plane. Note the curved needle path.
- b** The needle (not the suture itself) is grasped with the needle holder and pulled. The suture is pulled through until the short end appears in the magnified field of view.

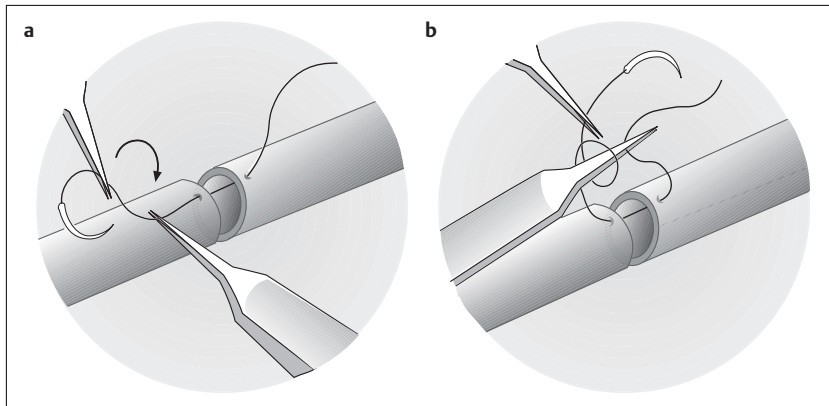


Fig. 14.6 Tying a **right-handed knot**.

- a** Held in the left forceps or micro-needle holder, the suture is passed once clockwise around the right forceps for an ordinary knot or twice for a surgical knot.
- b** The suture is pulled through for the initial knot. A second knot can be added in the opposing direction (see Fig. 14.7).

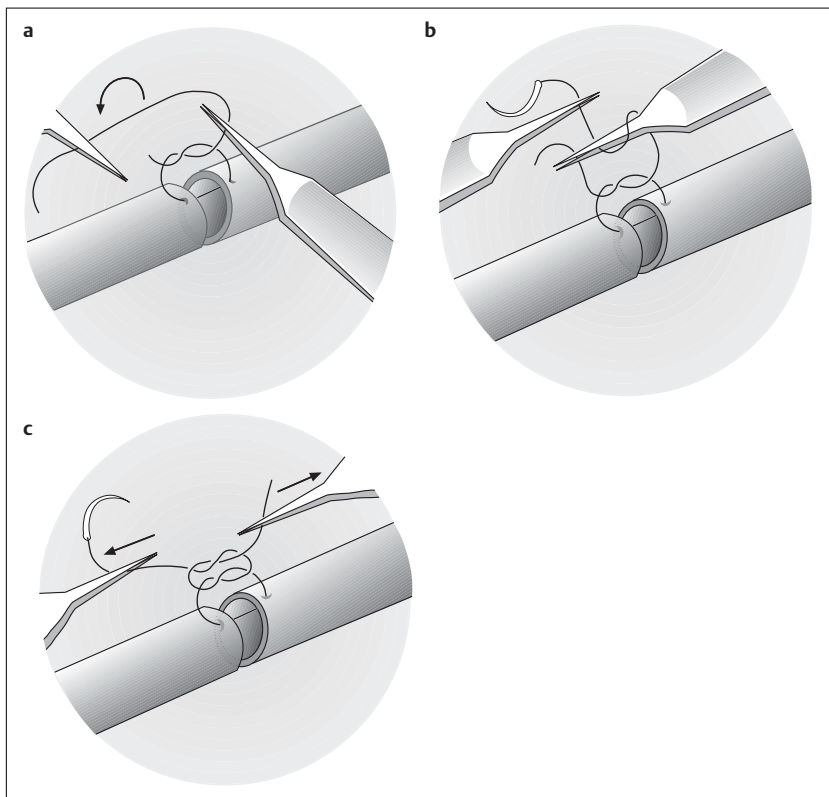


Fig. 14.7 Tying a **left-handed knot**.

- a** Held in the left forceps, the suture is passed counter-clockwise around the right forceps.
- b** The other end of the suture is grasped with the right forceps.
- c** The knot is pulled tight.

Microvascular Anastomosis in an Experimental Animal: Vascular Dissection in the Rat

(Fig. 14.8)

End-to-End Anastomosis of the Abdominal Aorta and Femoral Artery, Diameter 1–1.5 mm

(Figs. 14.9–14.11)

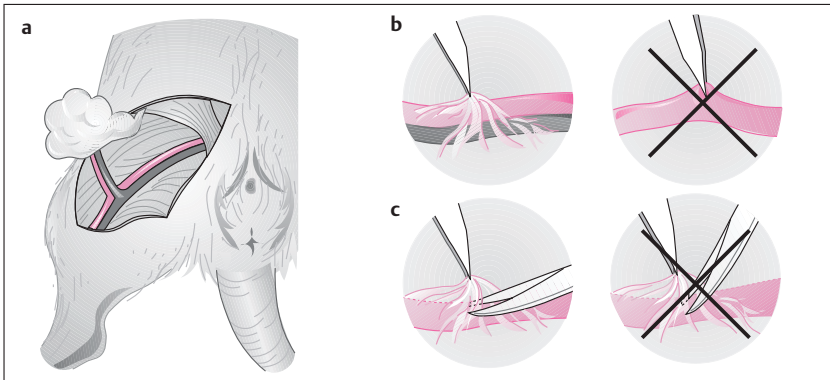


Fig. 14.8 Dissection in a rat with exposure of major blood vessels.

- a Supine dissection exposing the abdominal aorta, vena cava, and femoral vessels.
- b The surrounding connective tissue is dissected off the vessels, grasping only the adventitia.
- c The scissor dissection is directed parallel to the vessel axis.

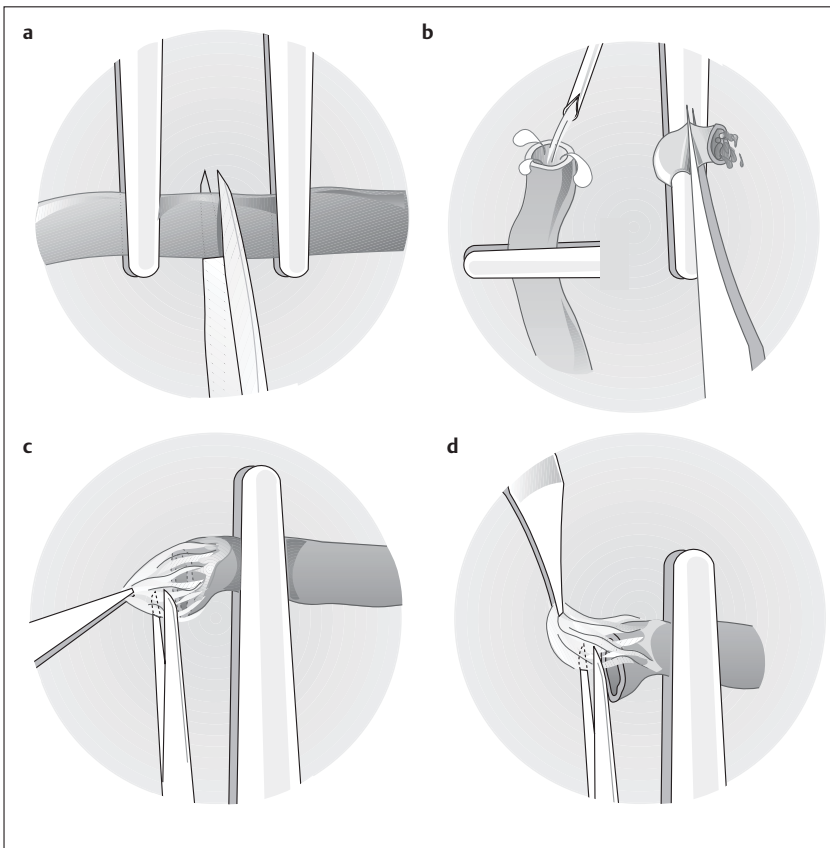


Fig. 14.9 Preparing the **skeletonized vessel** for anastomosis.

- a With the approximator in place, the vessel is divided perpendicular to the vessel axis.
- b The cut ends are flushed out with heparinized Ringer solution and/or milked with the forceps.
- c, d Projecting adventitia is removed along with any remaining connective tissue, completely opening up the circumference of the vessel. The tissue is pulled past the vessel end with a forceps and cut flush with the edge of the media (visible through the transparent tissue).

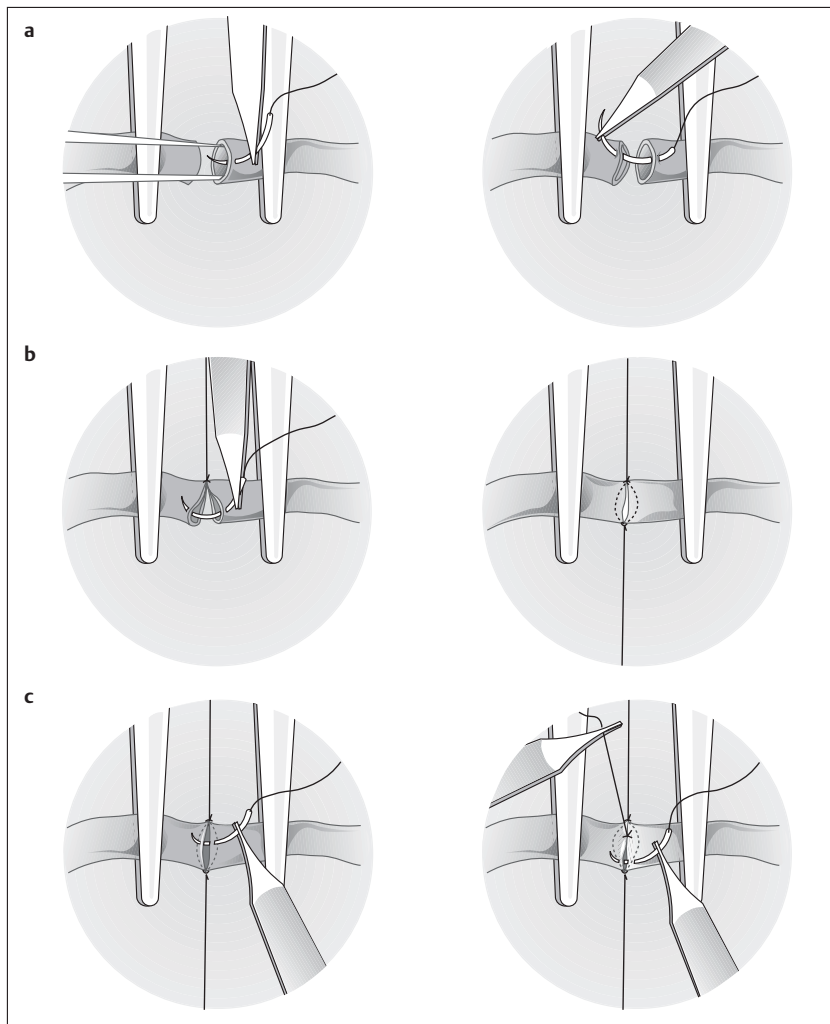


Fig. 14.10 The approximated vessel ends are sewn together with interrupted sutures. Placement of the **key sutures**.

- a** The first two sutures are the most important and most difficult. They are placed 120° apart in the line of the anastomosis (asymmetric biangulation). The left forceps is inserted into the vessel lumen and opened slightly to provide counterpressure for needle insertion (the forceps does not grasp the vessel ends).
- b** The **second key suture** is placed 120° from the first. This causes the back walls of the vessel ends to retract slightly, clearing the way for placing intermediate sutures in the front wall.
- c** Placing the **intermediate sutures** in the front wall.

End-to-End Anastomosis of the Inferior Vena Cava, Diameter 1–1.5 mm
(Fig. 14.11a)

End-to-Side Anastomosis
(Figs. 14.12 and 14.13)

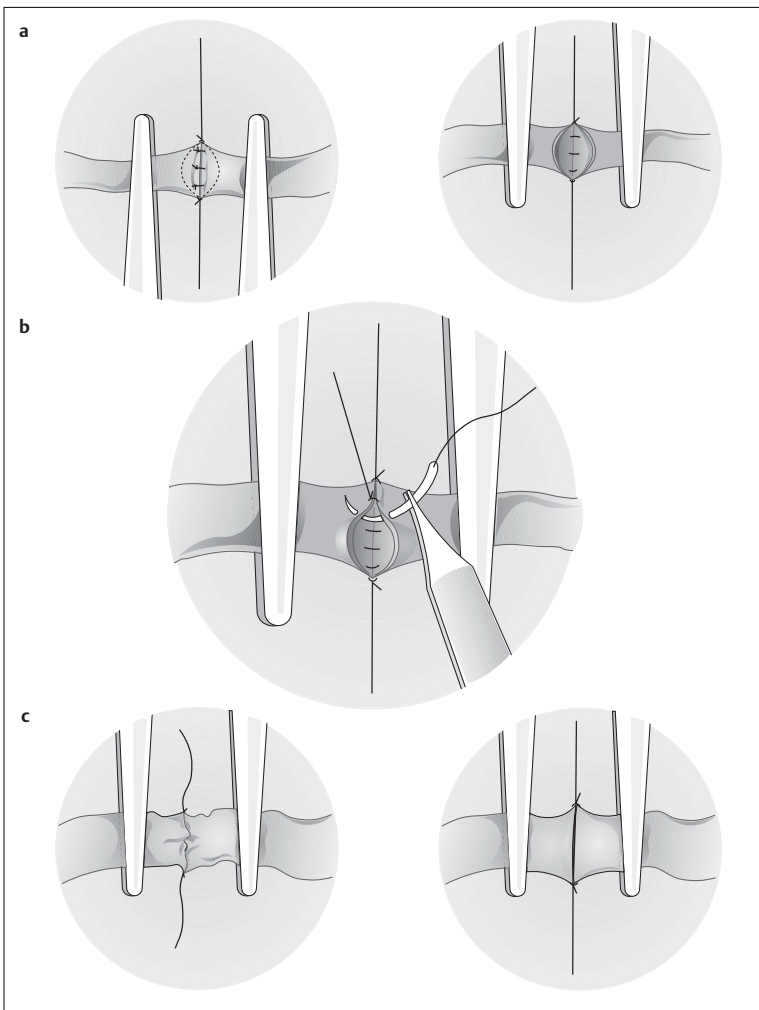


Fig. 14.11 After the front wall sutures have been placed, the approximator is inverted, **rotating the vessels 180°**.

- a** The vessel ends at this stage show a typical diamond pattern.
- b** The intermediate sutures are placed as they were in the front wall. Gentle traction on the final suture opens up the lumen slightly and reduces the danger of grasping the front wall.
- c** The end-to-end anastomosis is also used for veins. Traction perpendicular to the vessel axis places tension on the thinner-walled veins, opening up the collapsed lumen.

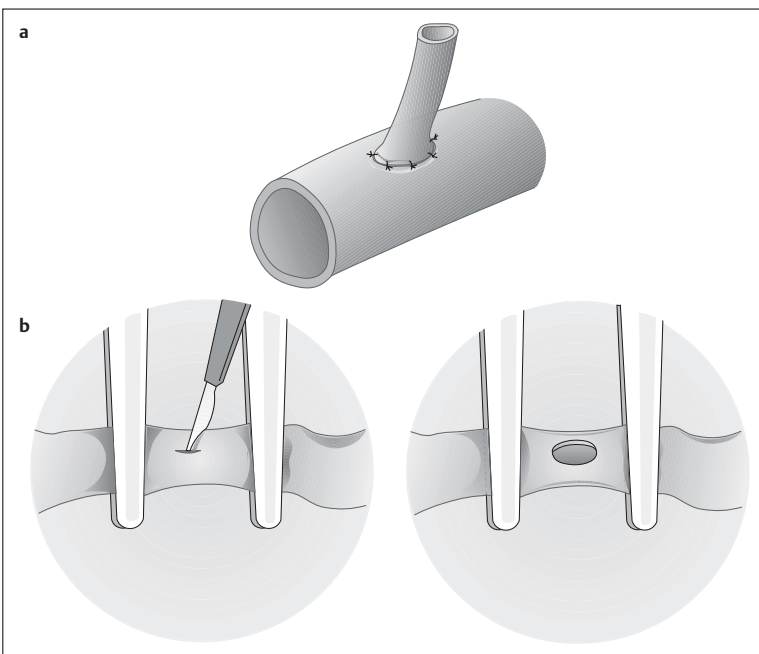


Fig. 14.12 **End-to-side anastomosis.**

- a** This technique is used to anastomose vessels of markedly different sizes, such as joining the typically small veins of a free flap to a large venous trunk at the recipient site. The suction effect provides for good venous return.
- b** The double clamps exert tension on the recipient vessel wall, which is incised longitudinally. The opening must match the lumen of the flap vessel. The elastic fibers in the vessel wall cause the opening to assume a rounded shape.

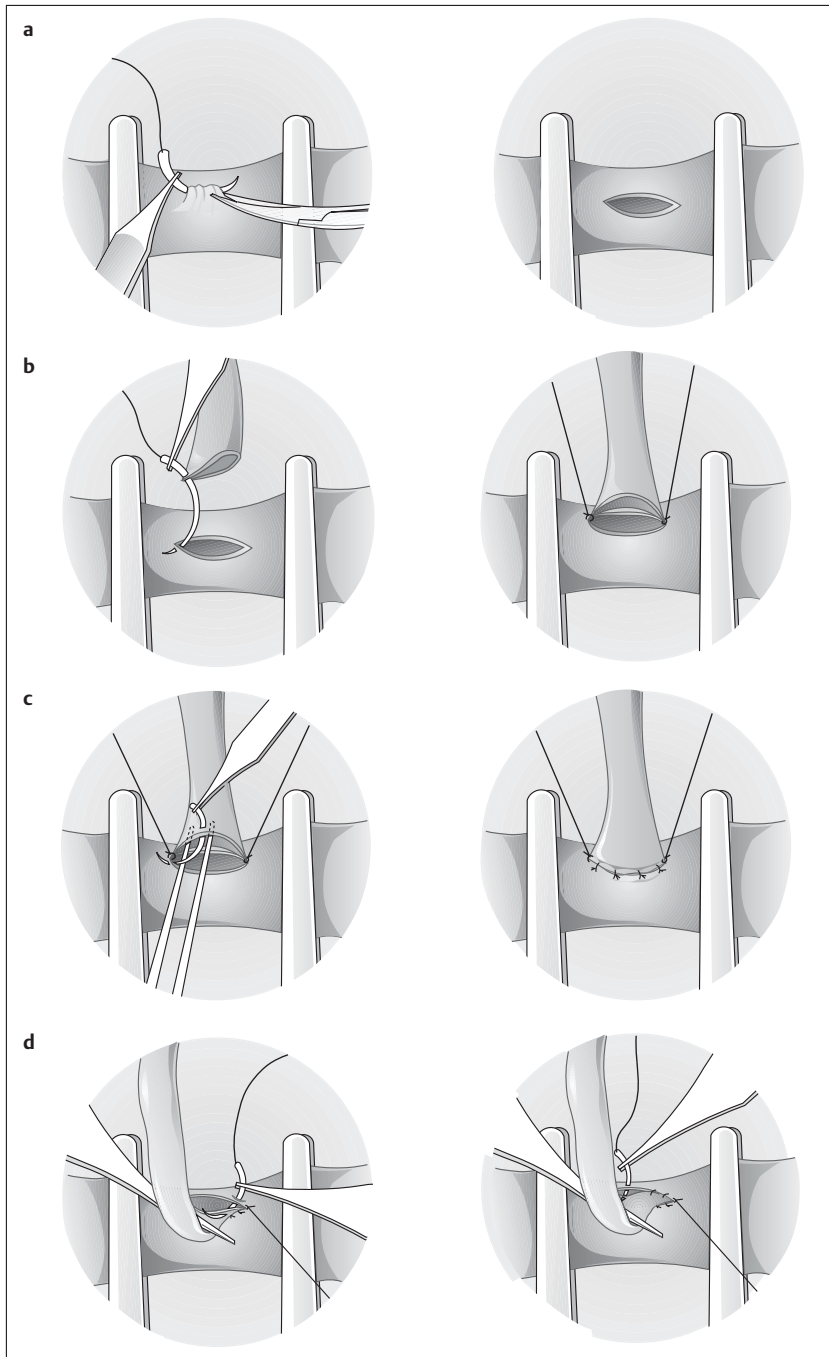


Fig. 14.13 Acland's technique of creating an **oval opening** for end-to-side anastomosis.

- a** The vessel wall is pierced with a microneedle. The wall tissue is elevated on the needle, and the raised area is excised with a scissors.
- b** The **key sutures** are inserted. The first two sutures are placed **180° apart**.
- c** The intermediate sutures are placed in the front wall.
- d** The flap vessel is lateralized with a forceps or heavy suture, and the **back wall is sutured**.

Problems and Complications

(Figs. 14.14–14.18)

- Inequality of vessel diameters (Figs. 14.14–14.16).
- Gaps between the vessel ends (Fig. 14.17).
- Early or delayed thrombosis at the anastomotic site (Fig. 14.18).

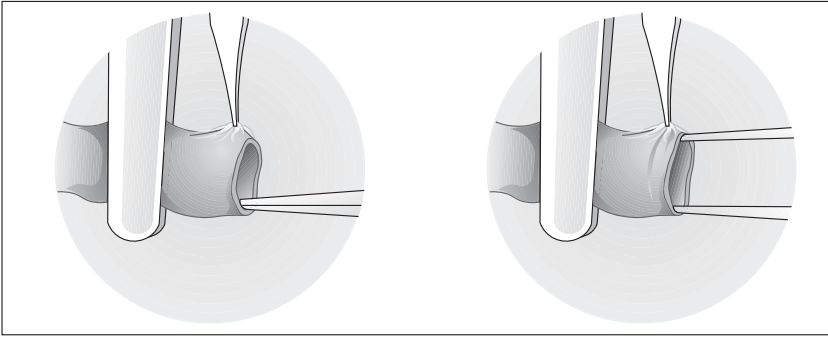


Fig. 14.14 If the **vessel calibers are nearly equal**, the smaller lumen can be gently dilated with a forceps or retractor.

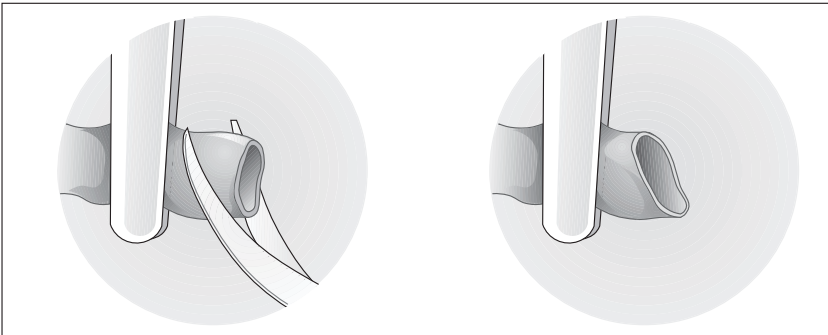


Fig. 14.15 Vessel calibers can also be matched by **cutting** the smaller vessel end at an **oblique angle**.

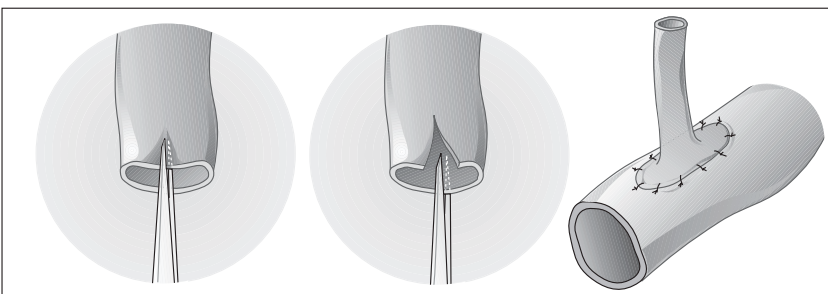


Fig. 14.16 **Fish-mouth technique.** The front and back walls of the donor vein are incised to enlarge the anastomotic lumen. This technique is particularly useful in an end-to-side anastomosis where the incision in the recipient vein has been made too large (Remmert 1995).

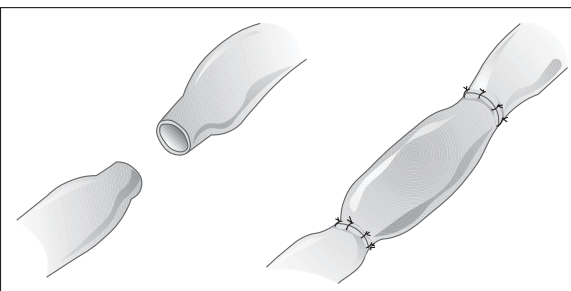


Fig. 14.17 **Gaps between the vessel ends.** The vessel ends must be apposed without tension, since traction on the anastomosis leads to thrombosis. Larger gaps should be spanned with an interpositional graft of equal diameter.

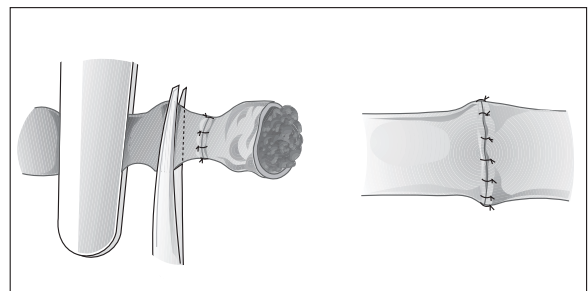


Fig. 14.18 **Thrombosis.** The most dreaded complication is anastomotic thrombosis. A clot that forms during suturing is flushed out with heparinized sodium-chloride solution. If the anastomosis has already been closed, the segment is excised and a new anastomosis is performed.

Test for Patency

(Fig. 14.19)

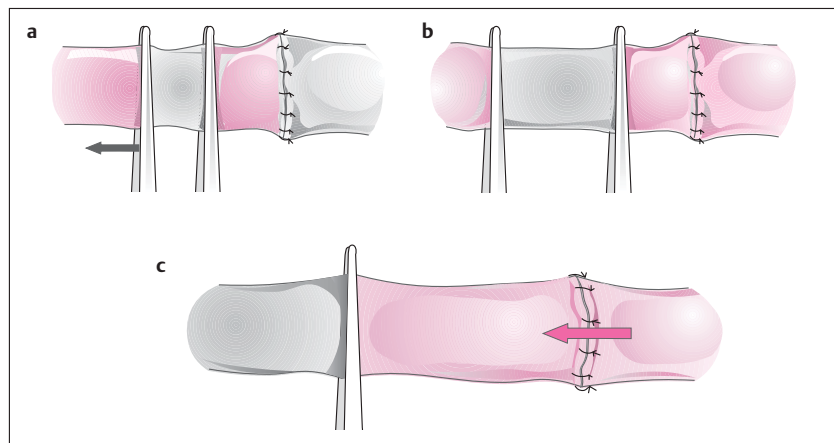


Fig. 14.19 **Test for patency.** The patency of arterial and venous anastomoses can be assessed with the O'Brien test.

- a** The vessel distal to the anastomosis is occluded with a forceps. A second forceps is placed next to the first.
- b** Blood is milked distally with the second forceps, which is tightened to create an empty vascular segment.
- c** The proximal forceps is released. If the empty segment quickly refills, the anastomosis is patent.

15 Harvesting a Bone Graft from the Iliac Crest

(Figs. 15.1–15.3)

Autogenous bone is needed for the reconstruction of defects or to correct cosmetic deformities. Along with the tibia, fibula, scapula, and ribs, the iliac crest is among the most common donor sites for autogenous bone. It can furnish extremely large grafts, which are usually taken in the form of compound or composite flaps that include soft-tissue elements (see Fig. 14.2).

Indications: Cancellous bone chips are used as filling material for mandibular reconstructions and bone cysts, and composite corticocancellous grafts of various sizes are used to correct facial contour deformities, augment the nasal skeleton, and replace portions of the mandible (Fig. 15.3).

Position: The patient is placed in the supine position with the hip (generally the right one) elevated on a cushion.

Approach: The somewhat thicker portions of the iliac crest (approximately 1.3–1.7 cm in diameter) are located in the anterior third between the anterior superior iliac spine (Fig. 15.1a, 3) and the iliac tubercle (Fig. 15.1a, Tub). The iliac spine is preserved anteriorly. An assistant presses down on the skin medial to the iliac crest so that the incision, and later the scar, will be lateral to the site where the bone graft is harvested. The incision should not be carried anteriorly past the iliac spine to avoid injury of the lateral femoral cutaneous nerve, as this would cause anesthesia or hypesthesia on the anterolateral thigh (Fig. 15.1b). The incision over the anterior iliac crest extends through the skin and subcutaneous tissue down to the periosteum. The length of the incision depends on the length of bone graft that will be removed.

Harvesting cancellous bone (Fig. 15.2): The periosteum is first incised along the lateral edge of the iliac crest. Then it is incised transversely behind the iliac spine and anterior to the tubercle, and the bone is divided transversely with an osteotome to a depth of about 0.5 cm (Fig. 15.2a). On the lateral side, the upper portion of the iliac crest is divided with a straight osteotome and fractured on the medial side. This forms a cortical cap that is hinged medially on the periosteum and attached muscles and can be opened like a trapdoor to expose cancellous bone (Fig. 15.2b).

The straight osteotome is advanced down along the inner surface of the inner and outer tables of the iliac

crest, and a transverse osteotomy is made behind the spine and in front of the tubercle. An osteotome curved on the flat is then used to cut through the base of the cancellous block (Fig. 15.2b). Harvesting of the cancellous bone is followed by meticulous hemostasis in which bleeding sites in the bone are first cauterized and then occluded with fibrin glue or bone wax. The outer and inner tables may be fractured toward each other slightly to reduce the size of the donor cavity. The cavity is packed with blood-soaked fibrin foam or collagen sponge, for example. The cortical cap is returned to its original position, the periosteum is reapproximated with sutures, and the wound is closed in layers. Suction drainage is essential to prevent hematoma formation. Two continuous suction drains should be used. One is placed at the bone graft donor site, maintaining suction for only about 30 minutes to prevent excessive blood loss; the other is placed in the soft-tissue mantle, where suction is maintained for 2–3 days. The cancellous bone can also be harvested with sharp curettes.

Harvesting corticocancellous bone (Figs. 15.3 and 15.4): Corticocancellous bone can be obtained from various regions of the iliac crest, depending on the necessary graft size (Fig. 15.3).

1. Small grafts (Fig. 15.3). The border of the iliac crest is an excellent donor site for small grafts used to reconstruct the nose, orbital ring, or facial contours. The periosteum is incised along the center and dissected from the inner and outer tables according to the necessary graft size. The graft is harvested with a straight osteotome or saw (Fig. 15.4a). After meticulous hemostasis, the periosteum is closed with absorbable sutures, and the wound is closed in layers over a suction drain.

2. Larger corticocancellous grafts (Figs. 15.3 and 15.4). The desired graft size will determine whether it is necessary to strip the medial periosteum with the iliac muscles, the lateral periosteum with the attached gluteal muscles, or the periosteum on both sides. The inner table is easier to expose, and larger corticocancellous grafts should be taken from the inner table whenever possible (Fig. 15.4b). This leaves the outer table with the gluteal muscle attachments intact. The anterior superior iliac spine with the tensor fasciae latae attachment should also be preserved. The grafts can be harvested with straight and curved osteotomes or with a motorized saw.

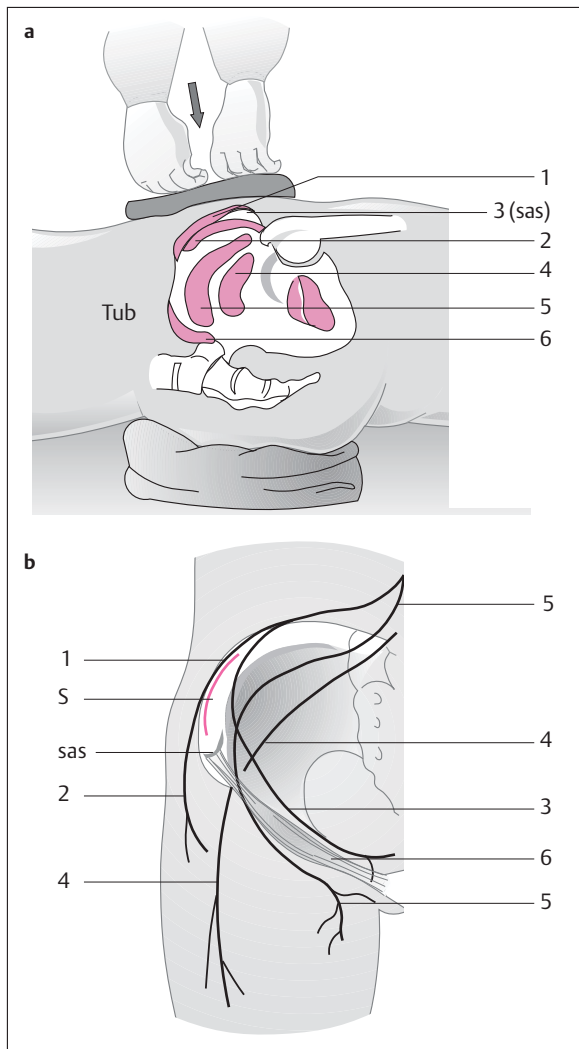


Fig. 15.1 Iliac crest bone graft.

- a** Position of the patient. Pressing down on the abdominal wall draws the skin medially across the iliac crest, positioning the incision and scar lateral to the crest. The diagram shows the inserting muscles, which are partially detached along with the periosteum.
- 1 Internal and external oblique muscles
 - 2 Tensor muscle
 - 3 Sartorius muscle
 - 4 Gluteus minimus muscle
 - 5 Gluteus medius muscle
 - 6 Gluteus maximus muscle
- (sas = anterior superior iliac spine; Tub = iliac tubercle)
- b** Sensory nerve supply of the leg (in the standing patient).
- 1 Iliohypogastric nerve
 - 2 Lateral cutaneous branch
 - 3 Anterior cutaneous branch
 - 4 Lateral femoral cutaneous nerve
 - 5 Ilioinguinal nerve
 - 6 Inguinal ligament (sas = anterior superior iliac spine; S = incision).

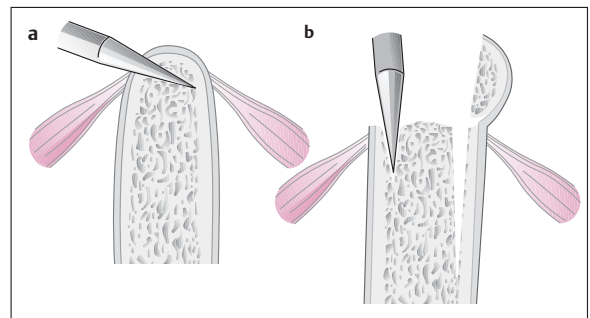


Fig. 15.2

- a** The periosteum is incised laterally, and the iliac crest is raised with an osteotome, leaving it hinged medially on periosteum and muscle.
- b** With the cortical cap opened, a straight osteotome is driven along the inner and outer tables of the iliac crest, and a transverse osteotomy is added to free the cancellous bone block.

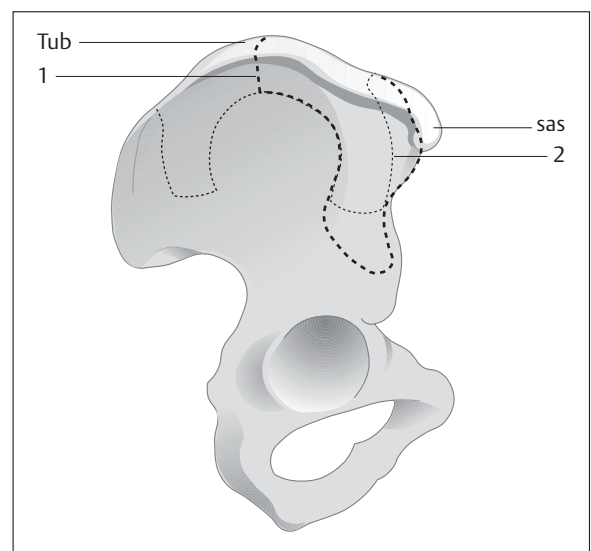


Fig. 15.3 Harvesting of large two-layer and three-layer grafts.

- 1 Graft for hemimandibular reconstruction.
- 2 Graft for anterior mandibular reconstruction (sas = anterior superior iliac spine; Tub = iliac tubercle). (Today this graft has been superseded by the fibular graft or pedicled iliac crest graft, see Fig. 14.2).

After the desired grafts have been obtained, the bone edges are rounded off with burs, rasps, or ronguers. A three-layer (full-thickness) corticocancellous graft can also be harvested, and again it is recommended that the superior border of the iliac crest be preserved (Fig. 15.5). In selected cases bone from the posterior iliac wing can also be used.

Hemostasis: Heavy bleeding, especially from the cancellous bone, requires meticulous hemostasis. This can be accomplished with bone wax and suction drainage (see above). Donor cavities are packed with blood-soaked fibrin foam or similar material. Blood loss in excess of 500 mL is not unusual.

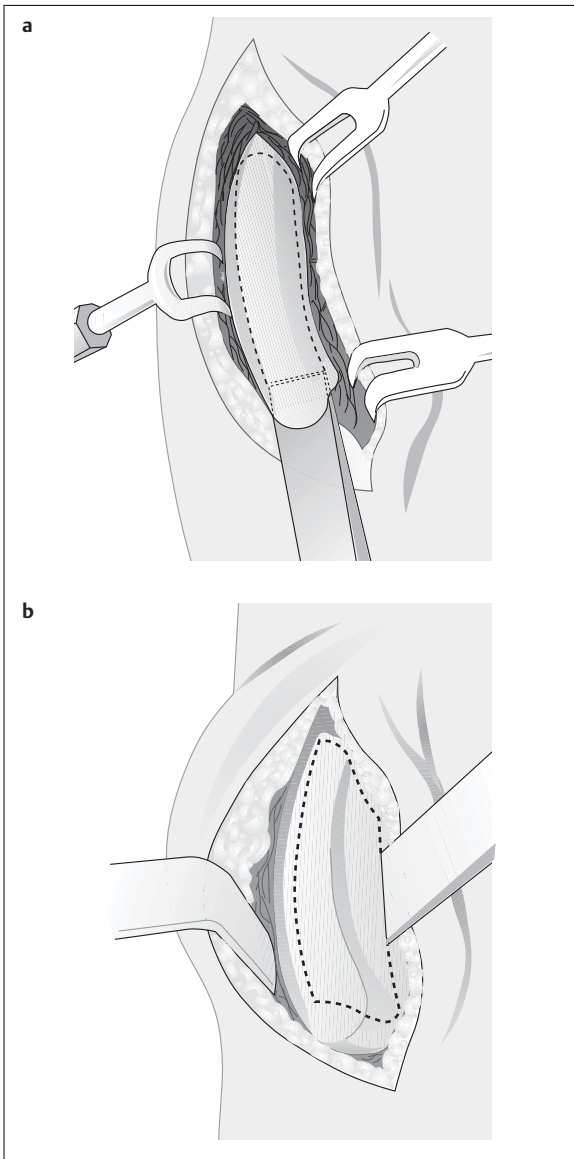


Fig. 15.4

- a** A small **cortical bone graft** is obtained from the iliac crest after stripping of the periosteum. The anterior surface of the iliac spine should be preserved (tensor fasciae latae).
- b** A **two-layer graft** (dotted line) is taken from the inner table after periosteal stripping. The anterior surface of the iliac spine should be preserved.

Wound closure: The wound should be closed in layers. When large bone grafts have been obtained, the iliac muscles can be sutured to the gluteal muscles over the iliac wing, and the medial and lateral periosteum are sewn together with heavy sutures.

Complications:

1. Hypesthesia or anesthesia on the medial surface of the thigh can occur if the surgeon did not keep strictly below the periosteum while working on

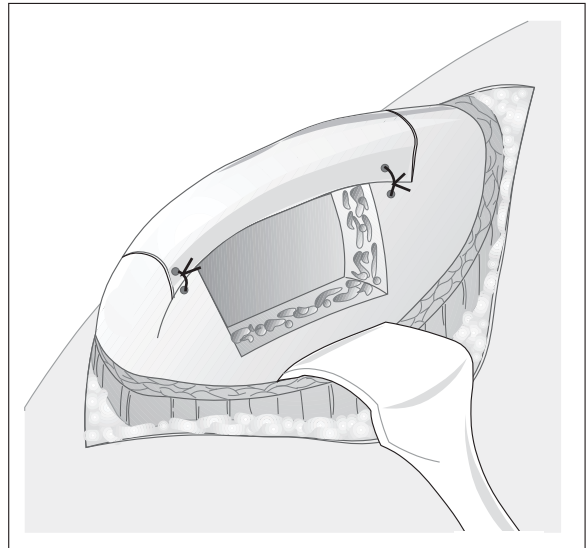


Fig. 15.5 A three-layer corticocancellous graft has been removed with preservation of the iliac crest, which is reattached after graft harvest. The iliac crest segment should be slightly larger than the graft.

- the inner table (Fig. 15.1b; cutaneous branch of iliohypogastric nerve, ilioinguinal nerve) or if the lateral femoral nerve has been injured (Fig. 15.1b).
2. Grating of the fascia lata over the trochanter can cause friction sounds during walking because the surgeon neglected to reattach the tensor fasciae latae to the lateral aspect of the iliac spine (Fig. 15.1b).
 3. Perforation of the abdominal cavity during graft removal from the inner table requires immediate closure in layers.
 4. A hernia may develop if the medial and lateral muscles are not sutured together after a large graft has been harvested from the iliac wing. Crockford and Converse (1972) suggested that graft harvest be limited to the outer table behind the anterior superior iliac spine in children over 2–3 years of age.
 5. Atrophy of the gluteal muscles (medius and minimus) can develop if the lateral periosteum is not repaired after graft harvest (Fig. 15.1a).
 6. The technique of preserving the pelvic brim (Fig. 15.5) should be practiced to avoid contour changes in the iliac wing (Laurie et al. 1984).
 7. Scars directly over the iliac crest can lead to problems when wearing belts, girdles, or the like. Also, the scars may be cosmetically objectionable in women, and hypertrophic scars may require later revision.
 8. Pain generally lasts from 4 to 6 weeks but may persist longer in some cases.

16 Dermabrasion

Dermabrasion is surgical scraping performed with a high-speed motorized handpiece (e.g., Aesculap) that delivers speeds of 15 000 to 25 000 rpm or higher. A large carborundum or diamond abrasive wheel is used.

Indications: Dermabrasion is done to remove scars above skin level due to burns or trauma, to lessen the visibility of traumatic tattooing, and to treat acne scars.

Procedure: Local anesthesia is the rule, but general anesthesia may be used when large areas are

abraded. While the skin is held tense and irrigated with clear, cool saline solution, the skin is uniformly abraded to a level no deeper than the boundary of the epidermis and dermis (Petres and Rompel 1996).

Complications: Persistent erythema, hyperpigmentation, or hypertrophic scarring.

Postoperative care: Cold compresses are used on the first postoperative day. Postoperative care also includes emolient skin ointments and protection from sun exposure.

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